11th QMOD Conference. Quality Management and Organizational Development Attaining Sustainability

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Editors
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CSR: A Fresh Perspective and An Integrated Proposed Model

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Abstract

Purpose: As the debate on the merits and de-merits of Corporate Social Responsibility (CSR) rages on, it is clear that the existing business mindset has changed and the acceptance of a wider range of responsibilities for business is becoming more prevalent as a practice. There are pretentious arguments but also contentious issues that cannot be ignored in relation to CSR. The purpose of this paper is to examine the various schools of thought on CSR, to examine the arguments and logics presented and to try and enrich the current debate by presenting a new perspective.

Methodology/Approach

Through case study analysis, the paper focuses on the practices of two organisations often quoted as pioneers in CSR and examines the effectiveness of the models used by both BP and Starbucks.

Findings The analysis of the two case studies involved has highlighted that CSR is a key driving force for modern competitiveness and acts as a catalyst for creating a competitive advantage.

Originality: This paper presents a fresh perspective which supports the notion that CSR has to make good business sense and the way to do so is have an integrated business perspective. Inspired by a description of CSR as "an exploratory journey towards the identification and creation of common benefits which demands commitment, co-operation and clear-sightedness from all involved" (Holme and Watts, 2000), the proposed model has been put together. The report published by The World Business Council for Sustainable Development specifically emphasises the importance of corporate values for driving the CSR agenda. The 5Cs in the proposed model are values-driven imperatives which will define what businesses must do, before evaluating what difference they must make.

Paper Type; Conceptual, research

Key Words CSR, Triple Bottom Line, Sustainability, Business Performance, Proposed Model.

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CORPORATE RESPONSIBILITY: A FRESH PERSPECTIVE AND AN INTEGRATED PERFORMANCE MODEL.

Introduction

Corporate Social Responsibility (CSR) is an emerging concept that has grown particularly over the last 10 to 15 years when businesses were increasingly being criticized by pressure groups such as Greenpeace, WWF and other groups applying and exerting pressure on businesses to change their habits and the way they do things. In particular CSR and has made a significant impact because it has focused significantly on environment and social issues. For instance when Shell was involved in the Brent Spar disaster, CSR has highlighted the importance of environmental responsibility. This has led to Shell being boycotted by a multitude of stakeholders. Although CSR means different things to different people, in a sense however, it considers the necessity for businesses to assume responsibility, not just in terms of activities that concern the customers, employees and shareholders but also it is about businesses responsibility towards communities and the environment in which they operate. So CSR can be construed to be a concept which has wider implications on businesses throughout their internal operations and their external interactions with stakeholders and other organisations and the environment in which they operate. Businesses are compelled to be diligent and compliant through statutory obligations in so far as safety and the environment is concerned, but in more recent years the move has been to add to the compliance the voluntarism mentality, which is for businesses to get involved in enriching and improving the quality of life of their employees, their families and the local communities and for society at large. Furthermore, there is an element that considers the ethical conduct of businesses in a global sense, and the way they deal, for instance, with employment, the way they do business and the way they commit to sustainability and the wider responsibilities on the plant.

The World Business Council for Sustainability and Development (Holmes and Watts, 2000) in its publication "Making Good Business Sense" uses the following definition:

Corporate Social Responsibility is the continuing commitment by business to behave ethically and contribute to economy development while improving the quality of life of the work force and their families, as well as of the local community.

 This definition implies that social responsibility of businesses becomes a wider concept that does not necessarily just focus on the philanthropic activities but keeps businesses focused on managing excellence, enhancing their performance, generating profit and delighting their customers and all of this to be done in harmonious mindset which makes businesses fulfill their duty and comply with the legal framework and generate benefits for all of its stakeholders. The definition also presents the wider responsibility of businesses from the point of view of a wealth creation process, which means that if the latter is to be managed properly, not only will this lead to businesses enhancing their competitiveness but also it

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means that the value creation process will have some sub benefits to society at large. It also means that there is an incentive for businesses to practice their wider responsibilities by doing more things and better things in the right way with the right mindset for the right reasons and leading to the right desirable result. This does not therefore mean that philanthropic exercises are veneered activities but rather they are core integrated with main business as the benefits can nowadays be quantified very easily.

There are so many interchangeable terms used to describe CSR. These include: Business ethics, corporate citizenship, corporate accountability, sustainability, business social responsibility. They all define corporate social responsibility from the point of view of commercial success, whilst honouring and subscribing to ethical values which transcend from respect for people and communities and the natural environment on the one hand, and also which means that total compliance and diligence with the legal, ethical and commercial requirements are adhered to. All of this is to be done with a spirit of raising standards of performance, raising standards of expectation and achieving a holistic integrated set of benefits to the expectation of all of the stakeholders. It is all about what businesses do, how they do it, when they need to react and how much do they need to impact.

It is unfortunate that CSR in many of the writing published is looked at as a 'nice to do' principle. However, CSR must be viewed as a comprehensive set of policies, practices, plans and programmes, which are part and parcel of business operations and value creation processes. CSR must also be seen as a catalyst to these decision making processes that are used on a daily basis in organisations, whether their concern is on direct value to the customers, or dealing with suppliers and partners or in terms of investing in technology and modernisation programmes or indeed in terms of the wider impact of businesses on the community on the global society, on the environment etc.

There is, however, no doubt at all according to different research studies, that CSR makes a lot of good business sense. CSR has impacted directly on business performance in a variety of ways. Several studies have indicated the impact of CSR on improving financial performance. For instance, a 2002 DePaul University Study which has demonstrated that the overall financial performance of the 2001 Business Ethics Best Citizen Companies were significantly better than that of the remaining companies in the S&P 500 index list. This is based on the 2001 Business Week ranking of total financial performers. CSR has also led to the conclusion that it can impact on reducing operating costs through ideas and initiatives that are practiced for environmental concern, such as reducing emissions and gases, recycling initiatives, waste disposal, the recycling of materials, and also through using people in the right way through flexible scheduling and the use of other work life programmes that have led to reducing absenteeism and increasing retention and employee motivation and satisfaction, thus leading to increased productivity and innovative contributions. Other studies have also concluded that CSR can impact significantly on enhancing brand image and reputation through customer satisfaction and customer contentment and also increase in sales and customer loyalty, increases in productivity and quality and the ability of businesses to attract and retain valuable and competent, talented people. Furthermore CSR has been found to positively impacting, on reducing harmful

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emissions. This is by going beyond compliance and using innovation to raise internal standards of managing safety and environmental issues.

There are several factors that indicate how gradually people's behaviour has been changing over the last few years and how CSR is being viewed as a necessary evil that senior managers cannot ignore. In addition to having a wider involvement of stakeholder activism and this has emerged through the recent scandals and unhappiness by the public on business conduct. There are, however, other sophisticated engagements through formal debate within industry sectors and industry association, and furthermore, there have been an exponential increase in codes of practice, industry standards and guidelines to enable organisations to apply generic principles of good practice, but also to encourage them to adopt CSR as an integral component of their ethical behaviour and their corporate governance. In addition we have witnessed significant increases in the level of transparency and reporting by businesses and the growth in government interest in the area of CSR. Lastly, we have also seen the synergy that has been created by focusing on CSR in the context of the wider government agenda.

It may be obvious to most businesses, it may also be normal common sense approach for the vast majority, however various studies have indicated that CSR still continues to be seen as a desirable goal and despite the emergence of a lot of research evidence that has correlated the benefits coming from commitment to CSR on various business aspects, there is still a struggle in getting businesses to drive the CSR agenda in the right way. It is logical for instance, to talk about promoting CSR as a vision for businesses through highlighting the internal benefits and the external competitive achievements that can be generated through the enhancement of brand image, through the inclusion of all the stakeholders and through rendering high value to various and differing expectations from, particularly customers and through leveraging and harnessing the strength of suppliers and others. It may also be logical to state that CSR by implication can only be pursued by widening the stakeholder perspective and developing smart partnerships. This is to support the decision making process on current and new developments that affect the value chain and which will have implications on the core stakeholders and which will also affect business capability and the sustainability of performance in the long term. Furthermore, there is the issue of integration of the CSR debate into existing strategies. This means that goal development, goal deployment, performance management, reward and recognition have got to look at the holistic set of expectations and have to induce the right behaviour within organisations so that people's mindset is changed positively and so that care for the environment, care for society and the importance of sustainability and continuity agenda are integrated in all aspects of business practice. Furthermore, businesses need to integrate the CSR agenda into the pro-active external engagement and the influence that businesses can generate at industry sector level, at government and wider levels.

CSR: The Benefits
There are several studies that have demonstrated how CSR can lead to tangible and intangible benefits and how it can support the development and growth of businesses in a variety of ways. For instance the survey carried out by The Economist Intelligence Unit in November 2007, has demonstrated that over the last three years or so CSR has been given growing priority by businesses in a very significant way (Fig. 1).

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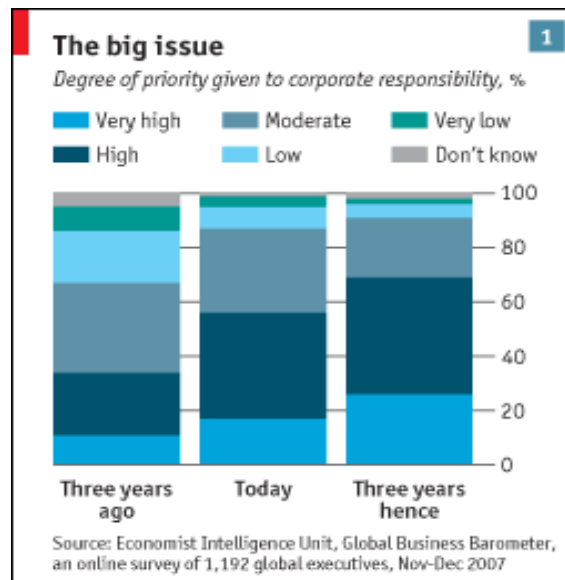
Figure 1

In terms of government attention given to CSR in Britain, for instance, the 2006 Companies Act has introduced a requirement for public businesses to report on social and environmental matters.   The United Nations similarly promote Corporate Social Responsibility around the world, using a group called Global Contact. A recent survey of CEOs conducted by the Mackenzie Company has concluded that 95% of the CEOs surveyed believed that society has now higher expectations of businesses taking on public responsibilities than it did five years ago. Similarly, investors who were starting to take a keen interest on environmental and social issues, and a survey has concluded that $1 out of every $9 under professional management in America is found to involve an element of socially responsible investment. This is according to a study done by Columbia Business School. A study carried out in 2005 has found that, whilst 83% of the leading Dow Jones strategic index performance have appointed a CSR committee, only 21% however, of the Dow Jones World Index of all companies has done something similar. This fall indicates that the leading businesses have adapted a structure where a Board of Directors address sustainability issues as a fundamental component of future strategies, and therefore have ensured a better quality and deep evaluation and formulation of sustainable strategies (Real Academia , 2007) ((Fig.2).

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Leaders General sample
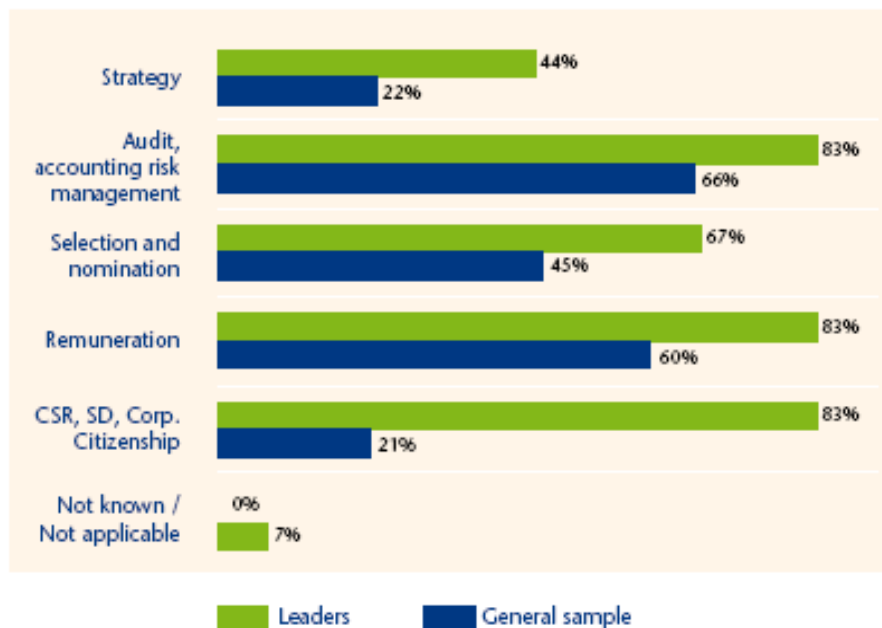
Figure 2: Appointment of Board Communities

Another study conducted by Goldman Sacks in 2007 (GS Sustain (2007) has concluded that sustainability translates into tangible commercial benefits. This study, which looked at six different industry sectors, had found that organisations considered to be leaders in implementing environmental, social and government policies and businesses that have designed policies and plans for creating sustainability from positions of advantage, have outperformed the overall stock market by 25% since August 2005. Within their own sectors 72% of the leading businesses have outperformed their peers over the same period. A separate study conducted by Mackenzie & Company has demonstrated that more than 90% of CEOs are doing more than five years ago in terms of incorporating environmental, social and governmental issues into their business strategies and operations (McKinsey & Company, 2007), A more recent study has shown that consumers gradually lean their preferences towards brands which demonstrate that sustainability is at the heart of their operation. This is not only in the B to C context but also the B to B context (The Emergence of Total Responsibility Management Systems , 2006) (Fig 3).

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Q: Consumers who have chosen to buy a product or service because of the company's ethical, social or environmental reputation – % yes

US	45%
UK	42%
Italy	35%
France	34%
Germany	28%
Spain	26%

Base: a representative sample of c.1,000 adults per market, February 2006

Source: The Emergence of Total Responsibility Management Systems (2006)
Figure 3: Influence of corporate sustainability on consumers:

That research has also demonstrated that sustainability is often found to be an aspect of corporate culture, thus increasing the commitment and motivation of future employment by increasing and demonstrating the rising number of prospective employees considering the elite and role models CSR committed businesses are likely employers.

Against this backdrop of good news in so far as CSR and likely benefits are concerned, there are however, other studies which demonstrate that businesses are still lagging behind in achieving the status and desired goals and furthermore, there are also several studies which demonstrate that external perception of business commitment to CSR is still not of the desired level. A survey conducted by Mackenzie between February to April 2007 has shown that whilst business commitment to environmental, social and governmental issues is at a reasonably high level from the point of view of integrating the aforementioned issues in their strategies and operations, nonetheless there is a significant gap in what they need to do and what they do at the moment. As figure 4 indicates, there is a significantly large gap particularly in integrating CSR in Global Supply Chain Management and there is another significant gap in terms of integrating CSR into the strategies and operations of businesses subsidiaries in various parts of the world.

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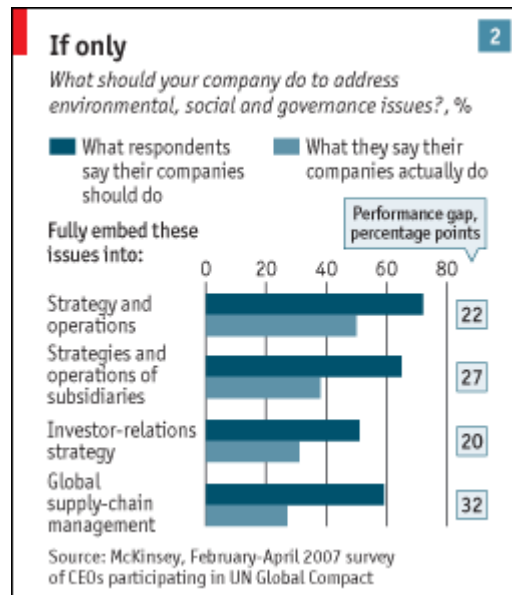
Figure 4

A survey conducted by Mori (2002) and focusing on a sample of 2001 British adults aged 15 + in various parts of Great Britain, conducted in August 2002, has concluded that there is still a significant gap in peoples expectations of what businesses should do and their perceptions of business commitment to CSR issues. As figure 5 indicates, the question on businesses commitment to CSR versus their commitment to financial performance, the survey indicates that the respondents still believed that businesses should significantly give more attention to CSR and to the same extent that they give attention to financial performance.

Society/Environment vs Financial Performance

Q   Which of these statements comes closest to your view? Companies should ...

Make a major contribution to society & environment, regardless of cost — 16%

Give most attention to society & environment, with some attention to financial performance — 14%

Give equal attention to society & environment as they give to financial performance — 50%

Give most attention to financial performance, with some attention to society & environment — 15%

Companies should maximise their financial performance, regardless of society & environment — 2%

Base: 976 GB adults 16+ July - August 2002

Source: MORI, 2002

Figure 5

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A very recent report released by IBM Institute for Business Value based on surveying 250 business leaders worldwide, Pohle and Hittner (2008), has found that businesses are increasingly using elements of CSR to differentiate themselves from competitors. They also use CSR for lowering costs and bolstering their bottom line. According to this study 68% of business leaders are using CSR to create new revenue streams, and 54% believe that their CSR endeavours are giving their companies a competitive edge. The report concludes, "CSR is no longer viewed as just a regulatory or discretionary cost ". The authors also conclude that CSR is"An investment that brings financial returns". The report identifies five areas where the leading businesses focus on; these include - regulatory compliance - strategic philanthropy - formal company value system - cost savings - creating new revenue streams.

CSR: The Rigmarole
Whilst CSR is gaining a tangible momentum in terms of the acceptability of the concept and the embracement of the philosophy and the adoption of the practice that is helping and has helped various businesses achieve community benefits which are internal or at a competitive level, nonetheless there are several schools of thought and the debate still rages on. One school of thought evokes a paper written by the late, great economist, Professor Milton Friedman, who in September 1970 has argued that businesses are there for making profit but not for having a social conscience. Friedman has always argued that in the context of the free market economy, businesses should adopt the free enterprise system, which means that they have to defend free enterprise and should be concerned with generating benefits from their stakeholders, particularly shareholders. Friedman concluded that "businessmen who talk this way are admitting profits of the intellectual forces that have been undermining the basis of a free society these past decades". Friedman was, of course, referring to businesses that have elected to adopt a social conscience and will take the view that the responsibility of businesses is to provide employment, eliminating discrimination, avoiding pollution and being a good corporate citizen. (Friedman (1970).

Friedman, in his paper has presented various arguments about the meaning of Corporate Social Responsibility by discarding its relevancy to the businesses and by appropriating it rather to individuals and leaving it to their clear conscience, so to speak. He concluded in his paper, "The discussions of the social responsibilities of business are notable for their unethical looseness and lack of rigour. What does it mean to say that business has responsibilities? A corporation is an artificial person and in this sense may have artificial responsibilities, but business as a whole can not be said to have responsibilities, even in this vague sense. The first step towards clarity in examining the doctrine of the social responsibility of business is to ask precisely what it implies for whom."

In concluding his paper Friedman says "there is only one and only one social responsibility of business - to use its resources and engage in activities designed to increase its profits so long as it stays within the rules of the game, which is to say, engages in open and free competition without deception or fraud."

Although Friedman has made his views 37 years ago, nonetheless it has generated a lot of debate among different schools of thought by those who are in support of the free market and free enterprise system perspective and those who believe that social consciousness is

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an integral component of doing business, particularly in the light of the various embarrassing situations that did arise in various parts of the world. The anti CSR argument basically discuss that leading companies have to focus on creating wealth rather than being the guardian of moral advocacy, as they also believe that creating wealth and producing superior goods means that this is a significant challenge that businesses must take into account, and being moral actors and accepting responsibilities for their other businesses misdeeds, make them more vulnerable and will create destruction in so far as delivering the true potential of what businesses can do. As the following argument explains, "today's leading companies are expected not only to create wealth and produce superior goods, but also to conduct themselves as moral actors - accepting responsibility for their misdeeds, and being responsive to the needs of others, and managing their own values and commitments. Contrary to theorists who for centuries have declared the corporation to be amoral, society today has endowed the corporation with a moral personality." Proponents of this school of thought argue that a company's main obligation is to stay in business and maximise maximum profit. This is done through contributing to society by remaining competitive and viable in the long term. If businesses remain viable and do well they will have fulfilled ultimately all of their responsibilities, including for instance enabling employees to keep their jobs, having suppliers who can also grow and prosper and keep their customers, and having customers who can continue to buy the products that they demand, and also having investors who are keen and willing to put money where they feel it is well protected. These anti CSR advocates also argue that any reason that pushes businesses away from making money towards mainly contributing to society will lead to significantly deteriorating effects and will negatively affect businesses competitive strengths. An example is always quoted where, for instance Walmart, one of the world's largest companies with over $245 billion in revenue in 2002, have achieved their success through ruthless practices by promising the consumer every day low prices, which has been done through cost cutting exercises on a continual basis and dictating the terms that increase efficiency through smart involvement of the employees, through squeezing suppliers on cost and creating an environment where value creation is heavily dependent on a continuous drive for generating big efficiencies.

There are, however, others who disagree with Milton Friedman's ideals and philosophy that he encouraged over 37 years ago. John McKay, the founder and CEO of Wholefoods, for instance in a recent debate in October 2005 has stated his views in relation to the CSR argument and this is in relation to the paper written by Milton Friedman and his re-iterated view in more recent years. John McKay, a strong advocate of Social Responsibility has written in response to Friedman's comments by saying, "I strongly disagree. I am a businessman and a free market libertarian, but I believe that the enlightened corporation should try to create value for all of its constituencies. From an investor's perspective, the purpose of the business is to maximise profits, but that's not the purpose for other stakeholders - for customers, employees, suppliers, and the community. Each of those groups defines the purpose of the business in terms of its own needs and desires, and each perspective is valid and legitimate." John McKay argues that his organisation would not have achieved the tremendous increase in shareholder value, since he led it from the inception, if it wasn't for their commitment to generating increase in shareholder value. However, it is the relentless drive for optimisation, for focus on customers, and for embracing best practice, for delivering value to the key stakeholders and working in partnership and caring for environmental society at large, that has been a successful

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philosophy for his business. He advances that the business model adopted years ago by Wholefoods could be construed to be a new form of capitalism which more consciously works for the good of a wide variety of stakeholders. He argues and insists that the current business climate is in bad shape and a fresh alternative is necessary. John McKay concludes that, "to extend our love and care beyond our narrow self-interest is antithesis to neither our human nature nor our financial success; it leads to the further fulfillment of both. Why do we not encourage this in our theories of business and economics? Why do we restrict our theories to such a pessimistic and crabby view of human nature? What are we afraid of?"

Perhaps, in concluding this section, one could say that neither argument is completely wrong or completely right. The truth of the matter is that the rules of the game are evolving quickly and that businesses nowadays are facing a new range of issues that they are expected to address quickly and in the right manner. When Freedman wrote his piece 37 years ago the rules of the game were significantly different. Of course he could not have predicted that these pervasive rules could emerge into a new trend and display a new pattern of pressures that businesses must respond to. For businesses in the 21st century it is a balanced view that needs to be displayed and this is what makes an essential component of their success. There is no doubt that CSR can enhance a business reputation, engage positively its employees, gets it to attract worthy and profitable customers and develop significantly positive and useful partnerships. What is required perhaps is not the abandonment of Freedman's doctrine of increasing profit, but rather to do so through being responsible in adopting the right business practices, not instead of them.

CSR: A Fresh Perspective
In the IBM Institute Report released in February 2008, addressing Corporate Social Responsibility, the arguments presented are fairly telling since they not only preach common sense but they demonstrate what best practice is and what businesses should do. This study has identified that the elements that tend to rank highest in the new activities include the following - creating new revenue streams 49% - strategic philanthropy 48% - cost savings 47% - formal company values 44% - regulatory compliance 28%. This therefore indicates that business leaders who are strong advocates of CSR are out facing their competitors twice as much because they emphasize on the spirit of collaboration and integration. In terms of collaboration the leading businesses spend a significant amount of time in understanding their customers' CSR expectations. Here lies a departure from traditional business practice, which tends to look at customer requirements from the point of view of point of services only. Furthermore, leading businesses in CSR practice have also got significantly rich databases and knowledge repositories with information on sourcing and dealing with logistics for driving their services and operations with CSR in mind from different parts of the globe. Leading businesses also collaborate with various partners and the end consumers themselves in finding total solutions with CSR issues being part of the value chain. These businesses also tend to engage their employees in CSR debates and practices bottom up and top down, in a mutually inclusive approach.

In so far as integration is concerned, leading businesses tend to place critical importance in having seamlessness in their Supply Chain Management activities, where CSR is a key driving component. They also claim to have exponential increase in their development activities for

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products and services that positively impact on the environment. They also support wider causes and community based projects by correlating closely the areas that they focus on in terms of philanthropy with their business ethos and business objectives. Another new report entitled "A New Mindset for Corporate Sustainability", Grayson et al (2008), as a white paper sponsored by BT and Cisco has also attempted to present a fresh perspective on CSR in an integrated manner. This report was acknowledging that the traditional business ethos of driving the value chain has delivered sustainable benefits to shareholders and other stakeholders at large, none the less the traditional model as the report states has a lot of obstacles to face up to now, particularly the use of resources, waste management, pollution, climate change and bio-diversity. The report argues that these issues now are becoming increasingly more relevant and important issues that must be addressed in order to maximise shareholder returns.

The report advocates a new approach to Corporate Responsibility, which pushes businesses to take obligation not only to the investors but also to the community and the environment in which they operate. They refer to this approach as S^2AVE. This stands for Shareholder and Social Added Value for Environment Restoration. As figure 6 indicates, this new mindset brings together various important and critically valuable components, which add value together in a synergistic way. This integrated system will drive corporate sustainable strategies and can generate innovation across all parts of the organisation.

Source: Grayson, D. et al (2008)
Figure 6

It however depends on business' ability to change its mindset to unlock these opportunities. The paper argues that this requires leadership to take meaningful action and not just to display words of encouragement. The report concludes by suggesting ten steps that could guide organisations for ensuring their corporate sustainability. These ten steps are referred to as the ingredients for sustainability/driven innovator:
1. Make innovating for sustainability a part of organisation's vision.

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2. Formulating strategy with sustainability at its heart.
3. Invest sustainability in every part of business practice.
4. Walking the talk.
5. Setting up a body with the power to make sustainability matter.
6. Setting firm rules.
7. Bringing stakeholders on board.
8. Using people power.
9. Joining a network.
10. Thinking beyond reporting; aligning all businesses with company's vision for sustainability.

CSR: The New Outlook

Having presented various arguments about how CSR has evolved over the years, what schools of thought exist in terms of supporting its worthiness and its relevancy to the 21st century and those that still insist on the hard nosed business approach that delivers maximum value to shareholders, and also having considered the emerging thinking, such as the new mindset report, it is now useful to consider a fresh outlook on how the current worthy experience CSR has provided, into an emerging pattern which is based on credibility and the validity of some of the thinking that businesses have been experimenting with over the past few years. Figure 7 is a proposed model which presents Corporate Social Responsibility as a composition of hard and soft elements working together, and reflecting a living cell that can grow and adapt to the external rigours of competitive markets and the environment in which businesses operate. On the other hand this proposed model integrates the hard nosed business approach with the wider responsibilities that businesses must engage in to and must take responsibility for.

Figure 7 presents a model which is driven by a compilation of soft factors that reflect the heart of business ethos (referred to as the 5 Cs) and the pillars that sustain businesses and supports their growth and development are referred to as the 7 Ps. Furthermore, the plasma and the fluid that feeds business growth and development is referred to through 4 Practices that leading businesses have been observed to adopt for driving passionately the growth and development of the businesses they lead that in terms of CSR being an integral component.

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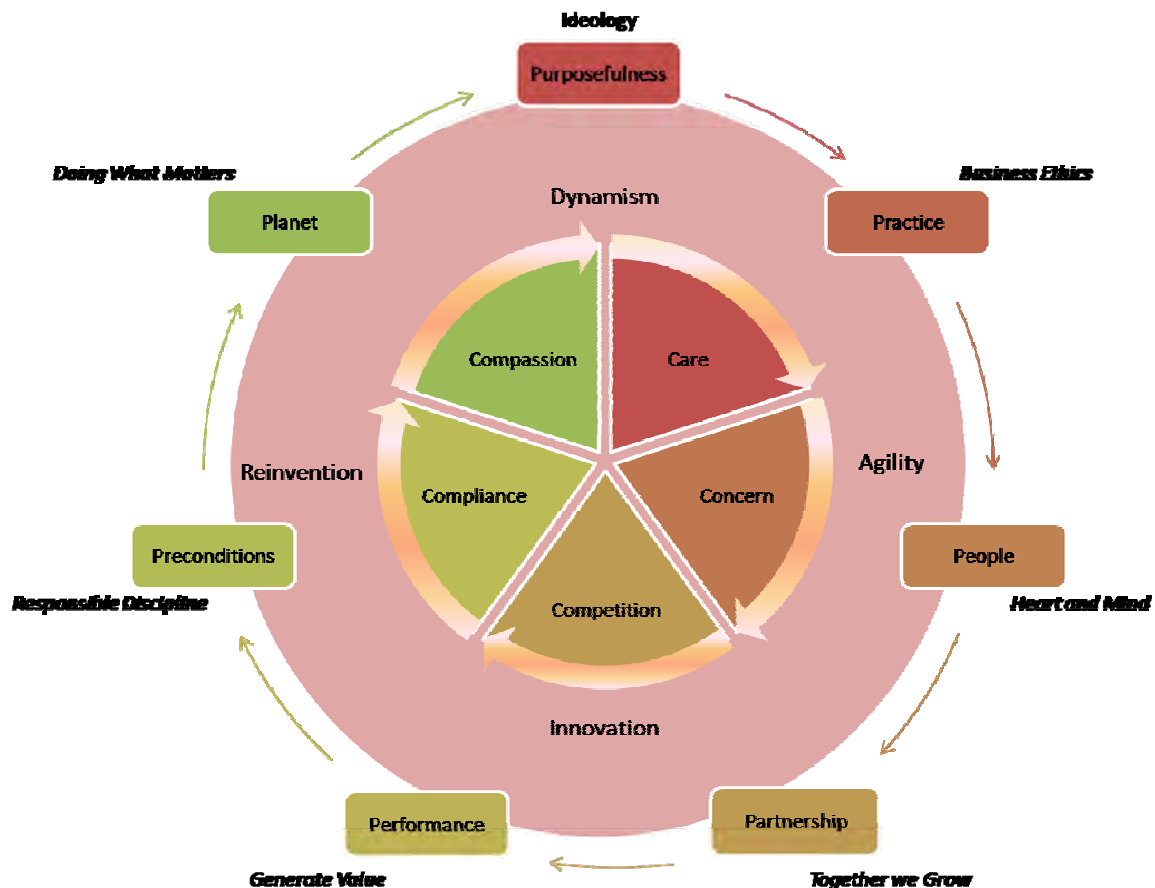
Figure 7

The Nucleus of Modern Sustainable Business

It is perhaps useful to describe a modern business that is driven by a sustainable mindset in the form of 5 Cs.

- Care

  Care for employees, and particularly in the year of the knowledge based economy. Unless businesses learn the process of attracting, nurturing, developing, engaging, motivating, rewarding, recognising and retaining talent, they are more likely to be going to fail, and one of the parameters of measuring business performance in a modern context is to look at their ability to attract the needed talent, the degree of participation and involvement, they have the results in terms of motivation and satisfaction, and of course the percentage of retention of critical talent.

- Concern

  Sustainable businesses must be customer centric, must development consentability to focus on customer needs and requirements, including the unspoken needs. As the IBM Report has illustrated by understanding customer needs in terms of CSR, this will also demonstrate the commitment of businesses in remaining sustainable.

- Competition

  Smart businesses are those that understand competition and the mark to which they operate and they can through benchmarking and best practice, continue to shoot ahead of the duck and create leadership positions for maximising their place in the

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market place, capturing sizeable market shares and delivering maximum value to their stakeholders.

- Compliance
  A good business is a well regulated business, but also a good business is a business which is consistent, that builds predictable and reliable operations and a business that has the ability to recover from distractions that do exist and happen all the time. By having standards and using various forms of audit and optimisation, a business can always adjust its temperature and can always focus on optimising efficiently and effectively.

- Compassion
  A business does not operate in isolation by ensuring that the system dynamics view is used. Businesses can find the synergy that exists between their operation and the vicinity of their community and other stakeholders who can influence their growth and development such as suppliers, for example, and the wider synergy that can be created through global factors, through sourcing and through outsourcing and doing so by demonstrating compassion towards communities, towards the environment, but also by ensuring that the win:win principle and the mindset of growing the cake together is more relevant and more meaningful than ruthlessness.

The Pillars of sustainable business

This model proposes 7 key pillars for creating a sustainable business that is driven by continuity and the integrated practice with a wide perspective:

- Purposefulness
  This means that sustainable businesses are driven by an ideology of long term existence and not necessarily through short termism, which has dogged thousands of businesses over the years and from which various lessons have been learned. It is clear to say that good businesses, sustainable businesses are those that have clearly defined constancy of purpose and they are driven by a purpose and not necessarily for just generating profit.

- Practice
  Sustainable businesses have defined laws, rules, policies, plans, procedures and practices that reflect their business ethos, and more importantly that regulate them through their ethical conduct. Well practiced businesses are those that define the path for their success, they do so by taking into account internal and external factors, by including the voice of their stakeholders, and by systemising the practices so that they have diligent compliance, aligned and committed employees and stakeholders in the process of driving the value chain.

- People
  Sustainable businesses are those that know how to win the hearts and minds of their employees and make them part and parcel of the decision making process that guarantees the sustainability in the long term. There are also those that involve employees proactively in CSR related issues.

- Partnerships
  With the motto "together we grow", sustainable businesses are smart businesses that know how to work in partnership with their suppliers, with other strategic alliances and are those that know how to leverage and operate through an open system perspective.

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- Performance
  Businesses are there to generate value. Value has to be quantified in a variety of ways, notwithstanding the importance of generating profit for investors and key shareholders, businesses do also produce value for their internal stakeholders, i.e. the employees, but also for the local communities and the global communities they interact with.
- Pre-conditions
  Good and sustainable businesses are responsible and they believe in discipline. They comply with the law, they apply the regulations and they avoid disasters and embarrassment. They are strong advocates of standards and they operate good governance in a transparent manner.
- Planet
  Businesses that are sustainable are businesses that have a clear conscience, in other words they do what matters, not just in terms of recycling and helping regeneration projects, but also they take it as a challenge for them to support the sustainability argument of controlling pollution, for example, controlling waste, and finding innovative solutions to problems that have negative implications on others and on the planet as a whole.

The Glue of Sustainable Business

Having described the nucleus of best practice sustainable businesses and also having referred to the 7 Pillars that create the solidity and the robustness of creating sustainable businesses, it is now important to look at the DNA aspect for the glue that holds together the mindset described in the form of the 5 Cs and the membrane, the structure or the pillars are described as the 7 Ps. This DNA can be described through 4 key aspects:

1) Dynamism
   Dynamism in the context of a sustainable business means that it is incumbent on the leadership team to continuously evaluate, assess, examine and challenge status quo and to ensure that the future path is well depicted and plans that can carry the growth and development and safeguarding of the businesses are in place. This is not necessarily done through a well defined structure, well elaborated strategies and plans, but more importantly in terms of searching issues of conscience, exploring issues from the point of view of others, so it's outside in, mainly involving external stakeholders, but also looking at and listening to wider point of views, and social conscious arguments, mainly.

2) Agility
   Agility is building the ability to move fast, to move innovatively, to be responsive and to support the drive for value, and to support the enhancement of a business sustainable strategy. It also means that the implementation of new practices and the adoption of new principles, and the changing of road maps and plans, and the re-structuring of methods of work, and the engagement of talented people is constantly under review to represent the clear direction and the optimisation of the ethos of creating more value, but also creating more predictable, sustainable practices.

3) Innovation
   It has been clearly demonstrated by various studies, that the adoption of CSR as a core element of creating sustainable businesses enhances significantly their

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innovative capability. More importantly, excellent innovation can be stirred by presenting the economic argument with the socially conscious argument, as two faces of the same coin. Indeed, whether it is to do with cost reduction or saving of a CSR mindset, or whether it is to do with brand enhancement in terms of creating socially desirable practices, the innovative return on investment projects are part of that DNA practice that must exist for ensuring the sustainability route.

4) <u>Reinvention</u>

Going back to Professor Milton Freedman's arguments, there is also always the risk of creating an oversight in terms of tablet of stone arguments and practices and values and the evolution and development necessary for businesses to pursue in order to ensure sustainability. With this in mind it is important therefore, that reinvention as a practice is an argument that massively explodes all the time so that business practice remains compatible with the rigours of modern competitive market environment, there also must be in line with sustainable practices driven by purposefulness and by sets of values that most people believe in and adhere to.

MODEL VALIDATION: BEST PRACTICE CSR IN STARBUCKS & BP

Starbucks Corporation is the leading retailer, roaster and brand of specialty coffee in the world, with more than 15,000 company-operated and licensed locations in North America, Latin America, Europe, the Middle East, Africa and Asia Pacific. From Starbucks' founding in Seattle as a local coffee bean roaster and retailer, Starbucks has expanded rapidly. In the 1990s, the company was opening a new store every workday, a pace that continued into the 2000s. Domestic growth has since slowed, although the company continues to expand in foreign markets and is opening seven stores a day worldwide. The first location outside of the U.S. and Canada was established in 1990s, and they now constitute almost one third of Starbucks' stores

Starbucks brand portfolio offers a wide variety of consumer products including Tazo® teas, Starbucks Entertainment CDs, bottled Ethos™ water, Starbucks® ice cream and Starbucks™ liqueurs. The Seattle's Best Coffee and Torrefazione Italia coffee brands enable Starbucks to appeal to a broader consumer base by offering a variety of coffee flavor profiles. Starbucks also sells coffee-brewing equipment and other merchandise. With headquarters in Seattle, Starbucks Corporation is incorporated in Washington State, in the United States. The company's common stock is traded on the NASDAQ® Global Select Market ("NASDAQ"), under the symbol "SBUX." As of January 11, 2008, there were approximately 592,940 registered and beneficial shareholders of record.

By late March 2008, Starbucks had more than 16,226 stores worldwide, including 11,434 stores located in the U.S. On July 1, 2008, the company announced it was closing 600 under-performing company-owned stores and cutting U.S. expansion plans amid growing economic uncertainty. These closings have effectively ended the period of prolific growth and expansion the company began in the mid-1990s. Through various licensing arrangements and foodservice accounts, Starbucks® coffee and other products are sold in designated locations within airports, grocery stores, other prominent retailers, hotels and universities. Starbucks international licensed retail stores are operated through licensing

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arrangements and joint ventures, primarily with established retailers or restaurant operators, although some are wholly owned by Starbucks or its affiliates.

Starbucks commitment to CSR is clearly evident through its core values and the key principles in its mission statement. They place emphasis on people, customer, community, excellence and the environment. In relation to the environment for instance, Starbucks has an environmental leadership mission statement which focuses on : Understanding of environmental issues and sharing information with our partners, Developing innovative and flexible solutions to bring about change, Striving to buy, sell and use environmentally friendly products, Recognizing that fiscal responsibility is essential to our environmental future, Instilling environmental responsibility as a corporate value, Measuring and monitoring our progress for each project, Encouraging all partners to share in our mission. As *Table 1* clearly indicates, Starbucks has attained a CSR Leadership position by incorporating the fundamental principles of the proposed model in all aspects of their strategies, operations and performance outcomes.

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Table 1 : CSR Best Practices at Starbucks

Area	Evidence[1][2][3][4]
Care	• **Wellness:** Thrive Wellness combines education, communication and active participation to help partners improve and maintain their health. • **Equality:** Workplace policies actively promote equal employment opportunities, and strictly prohibit discrimination or harassment on the basis of race, national origin, age, sex, religion, disability, sexual orientation, marital status, veteran status, gender identity and expression, or any other basis, as well as any other basis prohibited by federal, state, local or provincial laws. • **Health and Safety:** Starbucks emphasizes partner awareness of our safety standards and any potential risks in the work environment. We reinforce company-wide awareness of our safety standards through training, safe work procedures, regular communication, inspections audits. • **Monetary Benefits:** Offering of S.I.P. – Stock Investment Plan (U.S. and Canada), Share Incentive Plan (UK), Future Roast – Starbucks 401(k) Plan (U.S.), RRSP – Registered Retirement, Savings Plan (Canada) to partners
Concern	• **Vision**: to raise industry standards for sustainability and to provide hope and opportunity for producers and their families. • **Quality vs. Price**: Starbucks work closely with people throughout the coffee supply chain – the farmers, millers and exporters in order to emphasize the importance of quality as the best, most sustainable driver of higher prices. Coffee and Farmer Equity (C.A.F.E.) Practices was designed to help ensure that high-quality coffee is grown and processed in a socially and environmentally responsible manner, an approach that extends throughout the coffee supply chain. • **Fair Trade Certified**. Starbucks and the Fair Trade movement share common goals – to ensure that farmers receive an equitable price for their coffee and have access to international markets. Working collaboratively with Fair Trade suppliers, sharing best practices, promoting economic transparency down to the farm level, and encouraging participating Fair Trade cooperatives to improve quality and sustainable production practices.
Competition	• **Collaboration**: Sharing the guidelines and scorecard for C.A.F.E. Practices with other companies that seek to develop sustainable coffee-purchasing practices. Starbucks also collaborate with others in the coffee industry, as well as with various international parties, NGOs and public agencies, to help address the challenges coffee farmers and their communities face. • **Knowledge Sharing**: Openness and willingness to share information and knowledge also led to case studies which have been made available to companies, academics and other parties for their use. • **Program Development**: Implementation of Supplier Social Responsibility (SSR) Program, and Standards for Manufactured Goods and Services to represent Starbucks overall approach to integrating responsible buying practices throughout Starbucks global supply chain for manufactured goods and services. • **Problem Solving**: Starbucks joined Business for Social Responsibility's Beyond Monitoring working group in 2007, which brings companies and stakeholders together to help address the root causes of social and environmental issues in global supply chains by developing a framework for identifying a successful supply chain strategy that includes buyer internal alignment, supplier ownership, empowerment of workers, and public policy frameworks.
Compliance	• **Equality**: C.A.F.E. Practices suppliers – and other entities within their supply network – must have certain practices in place that ensure safe, fair and humane working conditions; the protection of workers' rights; and adequate living conditions. The minimum wage requirements and addressing child labor/forced labor/discrimination indicators are mandatory. • **Public Policy**: Starbucks strive to comply with all applicable laws and regulations, and work fairly and honestly with government officials and others in the communities. Starbucks policy forbids partners from offering or making payments or gifts on behalf of the company in order to influence a government official, or from representing their personal views as those of the company.

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Compassion	**Community Investment**: The combined total of Starbucks investments in coffee-growing communities through some coffee contracts was $1.5 million in fiscal 2007. The funds were used to pay for 50 projects located in 11 countries, benefiting more than 50,000 local farmers, their families and community residents. **Society**: Starbucks stores make substantial efforts to buy products and services, such as baked goods, from local vendors. Local sourcing amplifies the positive economic impact of each store, resulting in the indirect benefits of creating new jobs, generating additional income for the community and providing increased tax revenue. **Civil Role:** Starbucks works closely with civic organizations to help them better understand the opportunities, concerns and challenges faced by local communities. Infrastructure, workforce development and urban revitalization are few of the issues they have addressed through these relationships. **Electricity**: Work with the U.S. Green Building Council to develop LEED (Leadership in Energy and Environmental Design) standards for the retail sector that set out best practices for environmentally sound design of new stores. **Water**: Use a representative sample of stores as a "test bed" to monitor energy and water usage as part of a comprehensive audit to help us determine conservation opportunities. **Paper**: Test the Environmental Paper Assessment Tool (EPAT) with our top two suppliers of paper products to help determine how to best incorporate the tool into the paper procurement decision processes. The decreases in post-consumer fiber and unbleached paper percentages were mainly driven by increases in tonnage but no significant increase to PCF or unbleached paper changes in product categories. We are close to maximizing PCF and unbleached in many categories without having operational impacts to products.
Purposefulness	**Principle**: Committed to respecting the rights of partners (employees). Guiding Principles is based on the values on which the company was founded and has always put people first. The guiding principle is to "provide a great work environment and treat each other with respect and dignity. - Starbucks Total Pay philosophy is to recognize and reward partners' contributions toward achieving the company's strategic goals and business objectives, while aligning with Starbucks Mission Statement and Guiding Principles.
Practice	**Ethics**: Upholding strong ethical corporate culture is paramount to Starbucks success. Starbucks Business Ethics and Compliance program supports partners in making ethical business decisions by communicating Starbucks Standards of Business Conduct, facilitating legal compliance and ethics training, and providing mechanisms for partners to seek guidance and voice concerns **Effective Communication**: Starbucks offer a flexible and progressive work environment that fosters open, two-way communication. Encourage their partners to share their thoughts, opinions and concerns about Starbucks and their work environment, and we value and respect their input. Partner input often helps shape Starbucks policies and actions as they strive to create the best possible work environment.
People	**Skill Enhancement:** Partners receive comprehensive training, beginning with a two-week Barista 100-level training program and offer an array of training and career development opportunities tailored specifically for partners. **Career Development:** MyPartnerCareer.com, which helps partners throughout Starbucks connect with peers, discover career opportunities within the company and access job-preparation tools. More than 120,000 partners have visited MyPartnerCareer.com since its launch in May 2006.

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Partnerships	• **Alliance**: In May 2006, Starbucks announced a five-year, $2.5 million commitment of cash and in-kind donations to the National Association for the Advancement of Colored People (NAACP). Starbucks and the NAACP work together to identify and support projects reflecting our shared commitment to social and economic equality. • **Involvement**: In 1998 Urban Coffee Opportunities, LLC (UCO) was created, a partnership between Starbucks and Johnson Development Corporation, a company owned by Earvin "Magic" Johnson. The goal of UCO is to bring Starbucks stores to diverse local communities in the U.S. • **Partner Network Program:** Designed to capitalize on the energy, passion, and experience of Starbucks partners in the advancement of Starbucks diversity and inclusion strategy. Built on a model of shared accountability, the program empowers partners to foster inclusion, develop solutions that contribute to business success, and enhance personal and professional development.

Performance	• In 2007, the Great Place to Work Institute, a research and management consultancy based in the U.S., and with international affiliate offices throughout the world, named Starbucks to several lists:
	   • 100 Best Companies to Work For in the U.S. (#16)
	   • Best Companies in Mexico (#2)
	   • UK's 50 Workplaces (Top 10)
	   • Best Companies to Work For in Latin America (#11)
	   • Best Workplaces in Spain (#23)
	   • 100 Best Workplaces in Europe

Preconditions	• **Awareness Creation**: Starbucks emphasizes partner awareness of safety standards and any potential risks in the work environment. Starbucks reinforce company-wide awareness of safety standards through training, safe work procedures, regular communication, inspections and audits. • **Health and Wellness:** Advocated for transparency in health care costs and quality, to ensure consumers /stakeholders can make informed health care choices. Starbucks advocacy and other efforts in this area are described below.
Planet	• **Environmental Leadership**: In the growing and/or processing of coffee, measures has been taken in place to manage waste, protect water quality, conserve water and energy use, preserve biodiversity and reduce agrochemical use. • **Awareness**: While Starbucks have been working to "green" their own operations, Starbucks have also sought to involve business partners. With the help of 3Degrees, Starbucks launched a website encouraging our partners to calculate their own carbon footprints, and offering them the chance to offset their impacts by purchasing RECs through 3Degrees.

Dynamism	• To continue the improvement of the Mission Review process, Starbucks plan to focus on two key areas in fiscal 2008
	   • Responding to partner submissions more quickly, while • encouraging even more substantive, personal responses.
	   • Improving visibility of the ideas expressed through Mission
	   • Review so that all levels of the business can benefit from internal and external thinking.

Agility	• Seattle Cultural Immersion Experience, a program designed to enrich Starbucks international partners' understanding of Starbucks culture, mission, values, Guiding Principles and coffee knowledge. This experience was redesigned in 2007 and has helped partners convey the Starbucks culture within their market and build enthusiastic partners around the globe.
Innovation	• Engagement: Starbucks offer a 10-cent discount in the U.S. and Canada to encourage customers to use their own "commuter" mugs for their beverages to contribute in reducing their environmental impacts. As a result, customers had increased their use of commuter mugs for their beverages to nearly 20 million times during fiscal 2007.
Reinvention	• Starbucks and the Earthwatch Institute's traditional environmental expeditions were revamped with a new program that enables partners and customers to work with scientists and farmers of the CoopeTarrazú cooperative in Costa Rica, a coffee farm that Starbucks buys from.

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BP p.l.c., previously known as **British Petroleum** but now using only the initials, is the world's third largest global <u>energy</u> <u>company</u>, a multinational oil company ("oil major") with headquarters in <u>London</u>. BP p.l.c. (BP) is a holding company. The Company three business segments: Exploration and Production, Refining and Marketing and Gas, Power and Renewables. Exploration and Production's activities include oil and natural gas exploration, development and production (upstream activities), together with related pipeline, transportation and processing activities (midstream activities). The activities of Refining and Marketing include the supply and trading, refining, marketing and transportation of crude oil, petroleum and chemicals products. Gas, Power and Renewables activities included marketing and trading of gas and power, marketing of Liquefied Natural Gas (LNG), natural gas liquids (NGLs) and low-carbon power generation through its Alternative Energy business. BP is the one making the most noise about alternative sources of energy, cleaner fuels and carbon footprints: Having now scaled up its innovative internal emissions trading system, the company has also invested in $CO2$ capture and storage through subsurface sequestration in Algeria and is pushing its first decarbonised gas to hydrogen plant in Scotland

BP Defined its social responsibility in order to counter the negative perception that the public had over oil companies. The PR campaign used was to "help BP transcend the oil sector, deliver top-line growth, and define the company as innovative, progressive, environmentally responsible…" To achieve that goal BP needed to be a company "that confronts such difficult issues as the conflict between energy and environmental needs and takes actions beyond what is expected of an oil company".

Despite the various challenges that BP has encountered during its CSR advocacy campaign or afterwards, the analysis in *Table 2* does however indicate that not only has BP managed to realign its business radically to give it a more positive brand perception but CSR has enabled BP to re-energise its strategic thinking and to draw significant benefits and excellent performance outcomes.

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Table 2: CSR Best Practices at BP

Area	Evidence[5][6]
Care	• **Safety**: Total workforce (employees and contractors), reported recordable injury frequency (RIF) in 2007 was 0.48 per 200,000 hours worked, the same as that for 2006 and our days away from work case frequency was 0.075 compared with 0.085 in 2006. BP annually benchmarks these safety performance indicators against its peers through industry associations and other groups. • **Incident Rates**: BP invested $6 billion in 2007 to renew their assets and to minimize the risk of major incidents. They also took steps to strengthen management of process safety and enhance the skills of relevant operational staff, from executive to plant level. • **Leadership Development**: BP had launched the Managing Essentials programme for managers, designed to enhance leadership development and drive continuous improvement in performance. They also restructured career advancement programmes for high-potential individuals.
Concern	• **Quality**: BP products represent quality, based on a foundation of excellence in safe and reliable manufacturing operations. • **Stakeholders Involvement**: Hosts regular meetings with investors on social and environmental issues, led by BP chairman or senior management. Non-financial subjects covered in 2007 included safety, integrity of plant and low-carbon technologies, including the development of biofuels business. • **Suppliers Engagement: BP** engages with suppliers in a variety of ways, including review meetings to identify mutual improvements in performance.
Competition	• **Benchmarking**: BP promote good practice for environmental management and practice the sharing of ERNP with industry partners through a benchmarking group, and at site level with regulators and business partners. BP continues to share information on the ERNP with non-governmental organizations who were involved in their development.
Compliance	• **Code of Conduct**: BP continued to promote a culture of ethical behaviour and compliance with laws, regulations and BP's code of conduct. Setup of independent confidential helpline, OpenTalk, which provides a means to raise any concerns over compliance and ethics, handled 975 cases (in 2007). • **Environmental management systems:** Twelve of BP largest operations had begun implementation of the new operating management system (OMS), which integrates and strengthens existing safety and environmental management systems. The aim is to have commenced use of the OMS throughout BP by the end of 2010, consolidating our drive for continuous improvement. • **Practice of Ethics and Compliance**: BP has 144 compliance and ethics leader (CELs) to embed the compliance and ethics programmed in the businesses. In their work with BP's businesses during 2007, the CELs and the central com0pliance and ethnics teams focused on how compliance is built into risk management processes.
Compassion	• **Community Investment**: BP continue to invest in education, from school-based projects to university research and develop work with local suppliers and businesses, including planning to standardize the way they screen the human rights records of suppliers. They also continue to explore ways of using our capabilities to meet the energy needs of low-income customer and intend to remain active participants in the Extractive Industries Transparency Initiative and Voluntary Initiative on Human Rights and Security. • **Alternative Energy:** BP Alternative Energy plans to invest around $8 billion over 10 years in alternative and renewable energy technologies. It intends to invest $1.5 billion in 2008. BP plan to continue advocating for action to reduce GHG emissions as well as providing low-carbon energy. In 2008, BP plan to invest $1.5 billion in alternative and renewable energy technologies. • **Carbon Footprint:** BP aim to have built 1,000MW of gross installed wind capacity by the end of 2008 and to grow solar sales to 800MW in the coming years Plans to progress for hydrogen power plants with carbon capture and storage including a major project in Abu Dhabi. BP Bioethanol plant in the UK is due to be commissioned in 2010 and will continue working with the Round Table for Sustainable Biofuels to develop standards for sustainable biofuels.
Purposefulness	• Sustainability: BP define 'sustainability' as the capacity to endure as a group: by renewing assets; creating and delivering better products and services that meet the evolving needs of society; attracting successive generations of employees; contributing to a sustainable environment; and retaining the trust and support of our customers, shareholders and the communities in which BP operate.
Practice	• BP's core group value is to seek to drive down the environmental impact of its operations by reducing waste, emissions and discharges and by using energy efficiently. In 2006, BP had brought together in a new group practice called environmental requirements for new projects (ERNP) aims to ensure that they design, build and operate all their new projects to consistent and high environmental standards. • **Supplier Ethics**: BP's make sure the suppliers are complying to legal requirements and where possible contract include a requirement to act consistently with the code of conduct when working on BP behalf.

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People	• BP uses a variety of methods to help employee to develop their capabilities throughout their careers – from e-learning coursework through to international assignments. The Discover BP programme offers those who are newly hired into the organization an overview of the group, how it works and how they can contribute to the business quickly.
	• BP foster an inclusive work environment, offering opportunities for all, based on merit and emphasize equal opportunity and diversity and inclusion (D&I) in human resources (HR) processes.
Partnerships	• BP help to improve access to energy through business development opportunities or community investment, in partnership with host governments, the private sector, NGOs and international aid agencies.
	• **Joint Venture**: BP have provided support to TNK-BP in its priority environmental areas of improving facilities and pipeline integrity, investing in programmes to reduce gas flaring and remediating its legacy of polluted land. They have also assisted with the development of the joint venture's environmental standards by sharing BP's ERNP and advised on minimizing the impact of operations in environmentally-sensitive areas.
Performance	• BP participated in relevant policy developments, such as the Extractive Industry Transparency Initiative, and we also fund research to support better management of resource revenues. As a result, the exploration and production projects generate significant tax revenues for governments and have the potential to distort local and national economies.
	• With BP global supply chains worth more than $40 billion per year in non-hydrocarbon expenditure, BP had make an important contribution to host countries and communities by encouraging local enterprise. BP choice of local suppliers had created much-needed jobs, wealth and stability.
	• The Sustainable Agriculture Water Management Project (SAWMP), valued at more than $16 million and which received a commendation in BP's 2006 group internal awards programme, is helping to improve access to water in the 'dry zones' of Sri Lanka.
Preconditions	• **BP** code of conduct represents BP's commitment to integrity, defining what is expected of every BP employee in five areas: health, safety, security and the environment; employees; business partners; governments and communities; and company assets and financial integrity.
	• BP industry had make a valuable contribution in many ways: through tax revenues generated and paid to governments; by investing in education and training and improving employment opportunities for nationals; by promoting revenue transparency in the extractive industries; and by providing affordable energy products to rural communities.
Planet	• Develop a leading low-carbon energy business across the value chain
	o Access cost-competitive supply
	o Capture distinctive world-scale gas market positions by accessing key pieces of infrastructure.
	o Expand gross margin by providing distinctive products and services to selected customer segments and optimizing the gas and power value chains.
Dynamism	BP has developed plans to ensure that they have the right number of people with the right mix of skills. The management of people is founded on unchanging principles, which include treating employees fairly; promoting diversity and inclusion; making expectations clear; providing open feedback; and ensuring compliance with laws, regulations and code of conduct.
Agility	• **Prioritization**: BP rolled out a new compliance risk management programme, which includes questionnaires used by teams to identify the specific points on which they need to comply with laws, regulations and the code of conduct that include a tool that teams can use to prioritize the risks they face and focus on mitigating them.
Innovation	• Following intensive market research, BP had developed an energy solution for cooking that gives consumers the option to use LPG, biomass or both. This cooking solution also uses a stove that is safer, more efficient and cleaner than traditional wood-burning methods.
	• BP solar business continues to promote and develop solar energy as a source of power for rural communities, with potential to improve the quality of life by providing energy for lighting, refrigeration and to pump water
Reinvention	• BP developed a strategic approach to local supply chain development, linking to the needs of their different businesses and driven by the individual features of local markets. Consequently, BP had redeveloped and redesigned tools and processes to improve supplier selection, development and performance management in emerging economies.

SUMMARY

- This is not the right time to perhaps say what is beyond CSR. As we continue to explore and dedicate more effort in understanding the meaningfulness of CSR and its impact on businesses, both in the short and long term, it is however, useful to

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present some of the concluding arguments that legitimise the importance of CSR in creating sustainability, but also in supporting the growth and development of businesses in a transparent and well informed manner. Perhaps, as a baseline argument it is important to highlight that for businesses to move from survivability to sustainability they have to create a new mindset which helps them move from reactive to what is referred to as receptive, and ultimately to a constructive and proactive argument, where CSR is a core element of driving sustainable performance.

- In addition, it is perhaps important to look at sustainability in a proactive manner by enriching the visioning process so that it drives the value chain with CSR as a catalyst, rather than looking at CSR as an outcome of creating value for the key stakeholders.

- It is also important that the practice of CSR has to be strongly correlated to the sustainability argument. In other words, whether it is to do with geography, community based projects, or environmentally based initiatives in the form of the Triple Bottom Line; organisations must tangibly measure the outcomes that CSR initiatives and investment give in terms of supporting value, growth, development and sustainability in its various formats.

- The pursuit of sustainability cannot be embraced as a bolt-on element. The best approach for businesses seeking to remain and exist for the long term is perhaps to re-visit their purposefulness and explore the values for which they have existed hitherto. Unless the values that they wish to espouse and inculcate throughout the organisation are supportive of a long term, sustainable argument, then the blockage will always exist and the incompatibility will always remain as a challenge.

Lastly, something that others refer to as sustainability entrepreneurship. This means that businesses must create tenability in the form of their organisational DNA right from the beginning, and examples always quoted are: Body Shop, for instance, Ben and Gerry amongst others. This means that the glue referred to earlier in the proposed model, must dictate what the sustainability entrepreneurship design would look like, and this will be the key driver for building long term pursuits of value, vision, generation, and sustainable achievements.

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DECODING THE CODE OF EXCELLENCE

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Abstract

Aim of the article is to elaborate, interpret, discuss and decode *Excellence* in a new way by focusing on some of the Critical Success Factors (CSF) for *Attaining and sustaining Excellence*.

Methodology: The framework used for analysis is an old text which explains how to attain excellence. Literature references from 2500 years back and to excellence literature from the last 25 years, together with a few case studies, are used to 'de-code' the meaning and the complexity of the old text.

Findings: After final reflections it is concluded that the old text contains deep meanings and cover the complex nature of attaining and sustaining excellence. The few sentences are a kind of code, a crystallized form explaining how excellence can be attained.

Originality/ Value: This kind of analysis has not been done before. It is believed that the findings will have a great value both for researchers and for practitioners as well as organizations which are trying to attain *excellence*.

Key Words: Personal and Organizational Excellence, values, caring, risking, dreaming, expecting, motivation, commitment.

1. Introduction

This paper is a further work of the editorial text for the special issue on 'Our Dreams of excellence – learning from the past and architecturing the future', Journal of Management History (Dahlgaard-Park, 2007).

After having researched several years on the subject of excellence, and after having written several research papers on the subject (see the reference list), including editing the special issue on excellence mentioned above, I was quite confident in my belief that I 'knew quite a lot about excellence' until my husband and I suddenly were confronted with an embroidery at a local fish market on a windy day in Seattle, May, 2005. We were attending the ASQ world conference which took place in Seattle and had just a couple of free hours to visit the local fish market (although it was known as fish market, you could buy many other local traditional products, too). We were standing in front of a small open showcase where an old lady were selling various hand made embroideries in different formats. The object which took my attention was a little frame where the following text was beautifully embroidered with small flowers around the text (see the picture):

Excellence
Can be attained if you...
Care more
Than others think is wise.
Risk More
Than others think is safe.
Dream more
Than others think is practical.
Expect more
Than others think is possible.

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Does the text represent common sense or wisdom? If so, how is this common sense or wisdom related to scientific knowledge? These were the first questions which came up in my mind when I read the embroidery text. I have read numerous books and scientific articles and have written and published thousands of words about excellence. However I could not convince myself that those scholarly/scientific books and papers written by highly intellectual people were saying better about excellence than the embroidery text expressed in a few sentences!

After having continued research about excellence, I still think that the explanation found on the embroidery in Seattle is one of the most beautiful ones where peoples' ideas about excellence throughout human history seems to have been tested again and again and finally crystallised in those short expressions which I here call *the code of excellence*. So the aim of this article is to 'decode' by elaborating, interpreting and discussing the code in order to 'discover' the hidden meanings and complexities of the code of excellence to which I have no other references than the Seattle Public Market. By doing this I also try to find out the relationship and linkage between common sense or wisdom and scientific knowledge.

Like most of other common sense and wisdom it is not possible precisely to identify the creator(s) of the code, nor the time of creation. Probably our ancestors collectively and gradually shaped the code of excellence throughout the history. What we can imagine is that the idea of excellence and our search of excellence have as long a history as human history.

As previous research have been carried out without knowing the existence of the code of excellence, I was very curious and highly motivated to investigate the newly found code in depth - partly in order to understand the relationships between earlier research and the code, and partly in order to test the validity of earlier conducted 'scientific work' whether they are corresponding to the hidden meaning behind the code of excellence. The idea of excellence may or may not have a lot of overlap to what were the unknown authors' ideas on the subject

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as we may be living in a very different time and different environments. In this article *the code of excellence* will be interpreted and discussed sentence for sentence and related to the contexts and references which were identified and discussed during my previous research. The paper starts in section 2 with the definition of excellence and a discussion of various models developed for attaining excellence. The following sections 3-6 are devoted to decoding each sentence through identifying, discussing, reflecting the contents.

The paper ends with an extract of a Danish research case initiated by one of the biggest industrial companies in Denmark. The aim of the research project was to identify factors for understanding people's commitment (another word for passion), as commitment seems to be one of the most critical factors for achieving excellence. The case is a good example of how the ideas, theories and models presented in sections 2-6 are closely related to people commitment and to companies' *pursuit of excellence*. The Danfoss case is supplemented with a recent Danish survey on importance on company values.

2. Excellence?

If you don't know what excellence is then it is difficult to know if or when you have attained it. So we have to start with a discussion about what is excellence.

Several people have tried to define excellence during the long history of mankind so it is natural and honest to declare that we don't know when excellence was first defined and we also don't know what the contents of this first definition were. But what we know with certainty is that the concept of excellence in relation to management and organizational performance was introduced 25 years ago by Peters and Waterman when they published their best seller book "In Search of Excellence - Lessons from America's Best-Run Companies".

The starting analysis model or framework used by Peters and Waterman was McKINSEY's *7-S Framework*. The models comprised the following seven success criteria for excellence:

Hardware: 1. Structure and 2. Strategy.
Software: 3. Systems, 4. Shared Values, 5. Skills, 6. Staff and 7. Style.

However, Peters and Waterman did not define what is excellence, but they observed that managers are getting more done if they pay attention with seven S's instead of just two (the hardware criteria), and real change in large institutions is a function of how management understand and handle the complexities of the success criteria of the 7-S Model. Peters and Waterman also reminded the world of professional managers that *soft is hard* meaning that it is the software criteria of the model which often are overlooked and which should have the highest focus when embarking on the journey to excellence. There is no doubt that Tom Peters, through his early publications and his management seminars, has had an effect on *excellence thinking* in North America during the 1980s.

Both before and after 1982 there have been many suggestions for a definition of excellence. According to the American Heritage Dictionary (1992), excellence is defined as "the state, quality, or condition of excelling; superiority". Furthermore the word excel is defined as "to do or be better than; surpass; to show superiority, surpass others".

As is expressed by Paul in the new testament excellence can represent "*whatever is true, whatever is honourable, whatever is just, whatever is pure, whatever is lovely, whatever is gracious, if there is any excellence, if there is anything worthy of praise*" (Philippians, 4:8)

Another old and more than 2000 years old Greek reference explains that excellence is inseparable with the idea of good, which can be defined by the unique properties of the object or activity it describes. It has meaning only by reference to the intrinsic qualities of a person, an object or an activity, so there is no "one expression of good", there is no "one good

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practice". Good can be evaluated only in relation to the means it serves and the function it performs since everything has its own particular excellence.

Excellence of a man is different from the excellence of a horse. The old Greek Arate is used synonymous to excellence and in its earliest usage the concept contained meaning of the act of living up to one's full potential. Arate as the idea of perfection and excellence was an important aspect of the Paideia, the process of educating and training of the boy into his genuine human nature in Ancient Greek. Later on Arate was applied to mean men who had developed inner virtues such as dikaiosyne (justice) and sophrosyne (self-restraint) which are represented in the training program of Paideia. Thus physical, mental and spiritual training were developed in order to achieve Arate (Paideia, 1945).

Similar meanings about excellence can be found in Confucius (BC 551-479). Achieving intrinsic quality in terms of practicing justice and character building has been one of the main themes in Lun Yu (Analects of Confucius). Self-control and self-development via lifelong training and education were not only considered to be the methods to realize one's full potential but also the way to achieve harmony in society in general. By that reason leaders role was especially emphasized by Confucius. His notion of Junji (Superior /Excellent man or leader) demonstrates this:

"*Junji (Superior /Excellent man or leader) makes people's merits to grow and demerits to decrease, while inferior man does the opposites*" (Analects, from Dahlgaard-Park, 2006).

From this standpoint excellence includes doing common, everyday things and excellence isn't necessarily determined by comparing a score or a performance to someone else. The *pursuit of excellence* comes from doing our best with a view of growing and improving in terms of realizing one's potential. Excellence must then be related to our efforts on how we continuously develop and utilize/mobilize the capabilities throughout our lifetime.

As a teacher/professor having had the experience of following students we know that some students may have excellent abilities given by God, but for some reasons he or she don't use the abilities in a good way, and another may have far lower abilities, but he or she is nevertheless fighting and struggling day after day and the final graduation result may be almost the same. In such a case there is no doubt in our minds who of the two cases and which result we will relate to excellence.

However in relation to management and organizational excellence the situation may be not so easy to evaluate. The problem or challenge here is to relate performance results to the abilities and the capabilities of the organization. When the word excellence is used in quality management it often refers to upgrading the level of organizational management to a level of excellence, which is necessary to provide excellent results i.e. products and services which delight the customers/ consumers.

The 4P Excellence Model

In Dahlgaard-Park and Dahlgaard (2003; 2007) a model - the "4P" Excellence Model - is presented which has proven to be a good framework model to be used when companies are planning to attain excellence. The model's 5 components are:

*Leadership, People, Partnership, Processes and Produ*cts.

The main message from this model is that *excellent products and services* are a result of building excellence into *People, Partnership and Processes*, and this requires a strong foundation – *Leadership*. It is assumed that a management without such leadership will not be able to create excellence.

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One important motivation behind *the "4P" model* has been to create a model that provides an integrated approach between various, and often conflicting aspects, such as soft (intangible) and hard (tangible) aspects, subjective and objective aspects, rational and irrational aspects, individual/personal and collective/organizational aspects, as there is no model which embraces these different aspects of organisational realities when building organizational excellence. The result became the "4P" model (Dahlgaard-Park & Dahlgaard, 2003; 2007) in which the people dimension is recognized and emphasized along with other critical excellence variables. According to the model *building excellence into the following "4P" develops Organizational Excellence* (OE): 1. People, 2. Partnership, 3. Processes, 4. Products.

Another motivation behind the suggestion of *"4P" model* is based on the recent awareness on human resources and its role in an organizational context as one of the most critical issues for any organizational improvement activity. From this viewpoint it is argued that the first priority of any quality or excellence strategy should be to build quality into people as the essential foundation and catalyst for improving partnerships, processes and products. But what does that really mean? In order to answer that question we need to understand human nature, needs, motivation, psychology, environmental and the contextual factors of human attitudes and behaviors because the project of "building quality into people" can only be carried out when we have a profound knowledge of people and psychology.

A quality strategy should preferably be implemented multi directional, i.e. through a top-down, middle-up-down and a bottom-up strategy (Dahlgaard et al. 1998). The strategy should follow the Policy Deployment approach (Hoshin Kanri), which has both the top-down and the bottom-up strategy included. Such an approach provides a framework for building quality into the following three levels (Dahlgaard-Park, 1999; Dahlgaard-Park & Dahlgaard, 2003): Individual level, team level and organizational level. An efficient quality strategy aiming at improving "the 4P" can only be developed based on an understanding of the interrelationships and interactions between these three levels as well as the critical contextual factors at each level in each given situation.

Figure 1 below indicates that building Organizational Excellence (OE) is initiated by *building Leadership*, which means recruiting leaders with the right values and competencies and developing leaders through education and training so that proper leadership is practiced. Leadership impacts throughout organizations are huge. For instance, leaders' behaviours will largely determine if core values (as for example trust, respect, openness etc.) will be diffused and will become a part of the organizational culture (Dahlgaard & Dahlgaard-Park, 2004).

The next level is *People,* which involves recruitment of 'the right people', training and education with the right values and competencies. Education and training of employees is essential for giving people understanding of the company's philosophy and values as well as the competencies (skills and know-how) needed for performing their job. Working on the people level also includes intangible aspects of individual persons' mental processes such as perceptions, thoughts, intentions, beliefs, motives, willingness, desires, self-motivation etc along with more tangible aspects of behaviour and patterns of interaction with others.

Building Partnership and Teams means that teams are established and developed, so that each team is able to practice the right and needed values and competencies in their daily activities. *Partnership* is established in all people relationships - within the team, between team members (intra-team), between teams (inter-team) and with other people or groups outside the team. Partnership also includes external stakeholders such as suppliers, customers, society and community stakeholders.

Building Processes means that leaders, individuals and teams day by day try to practice the needed values and competencies based on the principle of continuous improvement.

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Quality and *speed* are continuously improved and at the same time *costs* are reduced all through improved people relationships in the system. The strategy, for simultaneously improving quality and speed and reducing costs, is to identify and reduce waste everywhere in the supply-chain processes from suppliers to the customers. Here the overlapping principles, tools and methods of TQM (Dahlgaard et al 1998), Lean Thinking (Womack & Jones, 1996) and the Six Sigma Quality methodology (Dahlgaard & Dahlgaard-Park, 2006) can be used.

   Building Products means building quality into tangible and intangible products/ services through a constant focus on customers' needs and market potentials, and to practice the principles of continuous improvement parallel with innovativeness in new product/service development.

   The foundation, *building leadership*, supports the four other factors represented by the "4P" and all together the 5 factors comprise a roadmap to the "result", which is called *Organizational Excellence* (OE). As shown from the model, it is assumed that all 5 factors are necessary for achieving organizational excellence.

   Although we have called the model for achieving organizational excellence, the implication of the model can be extended to larger entities, e.g. societies, communities and country levels.
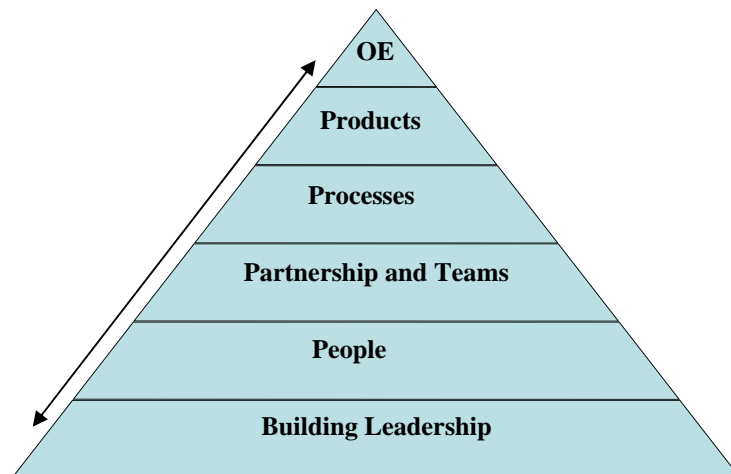
Figure 1: The "4P" Model for Building Organizational Excellence (OE)

3. Care more than others think is wise.
It is not difficult to relate this pre-condition for excellence to the people dimension of management and leadership. Many experts – academics as well as top managers/ leaders - have said that the first condition for achieving excellence is to have excellent people. This is the background for the "4P" model mentioned above. Excellent people will create excellent partnerships that will create excellent processes and products – which together define the characteristics of excellent organisations which further become foundation for excellent communities/societies. This is also discussed by Baccarani (2007) who discusses *what is meant by ethics* and specifies that *it is a wish, a search, a hope and an adventure of the spirit, which aspires to reach three objectives, without illusions of certainties*:
   1. Care for oneself; 2. Care for others; 3. Care for the organisation and for the society.
Here we suggest extending the care dimension further so that Care for the global society as

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well as the environment and the planet is explicitly embedded.

These suggested four levels are in line with the 4P model. Building people is related to care for oneself, building partnerships corresponds to care for others and building processes and organisations corresponds to care for the organisations. Below we will elaborate more on Care by treating the four levels one by one in depth.

Many have explored throughout human history the idea of *Care for oneself*. Motivation for religious and philosophical searches on the meaning of life may lie in our inner desire to care for ourselves and our life, and further to achieve harmony and inner happiness. Previously "care for oneself projects" were mostly taken care of by families and religions. However in the post modern society "care for oneself projects" is not only relevant for individual persons or for organizations. The projects became one of the most important social and global issues. Organisations are interested in "care for oneself projects" because there are many evidences indicating the co-relationship between happy and harmonious employees and the economic success of the organisation. For individual persons care for oneself or quality of life became an increasingly important issue parallel with higher education levels, higher living standards and higher demands for oneself. Quality of life became even an important indicator for the measurements of national wellbeing. Almost everywhere we are bombarded with material using the concept of 'quality of life', like an advertisement of summer book sales from a book club called LivsEnergi (Life energy) (July advertisement, 2007, translation from Swedish):

> "Welcome to the book club – LivsEnergi! LivsEnergi is more than a normal book club as we offer ideas and inspiration which can make members life more meaningful, exciting, more happy, and more harmonious".

People found out that their searching for happiness and meaningfulness, and thereby their search for achieving quality of life, were not fulfilled by achieving higher education, neither by material richness. Many statistical results show that peoples' perceptions of quality of life are either the same or have been worsened while GNP and material life standards have been improved significantly in many countries. We have believed that economic wealth will lead us to happiness and higher quality of life, but have now slowly realised that it is not always the case. So people are still "hungry" and continue their journey in searching on 'quality of life' because people really care for one self. It is however not so easy to understand what it means and how to attain quality in our lives.

Several Danish surveys carried out in 1998, 1999 and 2000 (Dahlgaard-Park & Dahlgaard, 2003), in a manufacturing, a service company and a public sector organization, illustrate people's perceptions about the quality of work life. The respondents were asked about what they regarded as "the most important factors for Quality of Work Life". The priorities from this survey are shown in table 1 below.

Table 1: Most important factors for Quality of Work Life?

Factor	Priority
Personal development (professional, intellectual and personal)	1
Recognition and self-respect	2
Meaningful work	3
A good physical working environment	4
Economy	5
Job security	6

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It is worth to comment that salary (economy) and job security only had the 5th and 6th priorities while personal development, recognition and self-respect, and having a meaningful work were the 3 top priorities in achieving quality of work life.

Personal Mastery (Senge, 1990), Self-Development, Personal Leadership (Dahlgaard-Park & Dahlgaard, 2003; Dahlgaard-Park, 2006), Self-Actualisation (Maslow, 1943), Flow (Csikszentmihalyi, 1990) are all well established scientific concepts which are related to care for oneself and at the same time they are also related to the highly ranked factors above for quality of working life.

Regardless how we call the care for oneself project we find some important ingredients in all the following concepts: *Self-knowing, self-monitoring, self-motivation, self-efficacy and self-esteem,* and *self-actualisation* (Gardner, 1983; Goleman, 1998; Dahlgaard-Park & Dahlgaard, 2003; Dahlgaard-Park, 2006).

Self-knowing is the ability to know and to recognize one's own inner feelings, preferences, values, motivators, desires, intuition as well as one's strengths and weaknesses. *Self-monitoring* is the ability to monitor one's own feelings, impulses, stress and changing environment, including the propensity to suspend judgement and to think before acting. To monitor one's negative feeling to a positive one is also an important self-monitoring ability. Self-knowing is necessary for practicing self-monitoring.

Self-motivation is the ability to motivate oneself and be able to establish personal goals based on one's inner desires and accurate knowledge of one's current stage. Persons who have high self-motivation are proactive in taking responsibility and searching means in achieving personal goals.

Self-efficacy (Gist, 1987) refers to one's belief that he or she is capable of performing a task. The greater a person's self-efficacy the more confident he or she is to succeed in a task. Persons who have high self-efficacy are also better to handle negative feedback. *Self-esteem* is closely related to self-efficacy and includes self-respect and self-confidence. People with self-esteem are able to recognise one's uniqueness and achieve something meaningful.

Finally *self-actualisation* is the driving force for fulfilment of one's potentials. Overcoming obstacles and achieving one's dreams and potentials may be the best way to care for oneself.

All these abilities are interrelated to each other. For instance without accurate knowledge about oneself, it is difficult to establish reasonable and realistic goals. Without self-monitoring and self-motivation ability people will not easily overcome stress, failures and negative feelings. They will be caught by these feelings like slaves rather than using and mastering them for their own sake. Caring oneself is in other words to be truly your own master.

Care for others can be explained by core values (Dahlgaard-Park, et al., 1998; Dahlgaard-Park & Dahlgaard, 2003) and empathy. *Core values* has been termed in various ways in human history such as virtue ethics or character ethics and are proven to have been everlasting values regardless of cultural and ethnical differences all around the world. Core values in terms of trust, honesty, openness, loyalty, integrity, sharing, fairness, humbleness, respect, love etc. have been widely recognised to be the guiding principles for people relationships. Modern literature adds one more important concept – the concept of empathy - into these widely recognised series of ethical codes for caring for others. *Empathy* is the ability to know or to understand others' feelings, needs, emotions, preferences and anxiety and the skills in treating people according to their emotional reactions. Empathy is an ability to understand others in depth. Core values together with empathy may enable us to build true win-win partnerships which can bring synergies because the raw materials for synergies are individual differences and uniqueness. Synergies will only be created when there are true respect and

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trust between individuals with open and sharing mindsets. Recognition of the value of diversity can be fostered in this synergetic atmosphere.

An indication for importance of Care for Others is shown in a Korean survey done in February 2006 by the leading Korean business newspaper Chosun Daily. The respondents were among others asked the two simple questions, which are shown in tables 2 and 3 below.

Table 2: The happiest moment in your working life?

When my work was recognised	46%
When I received unexpected bonus (29%)	29%
When I have social meeting with colleagues whom I like (9%)	9%
When my leader is on business trip	8%

Table 3: When do you hate to go to work?

When I have problems with my leaders or colleagues	29%
When my work is not recognised to be good	17%
When my salary is not matching my work	12%

We see that *recognition* is in the top which create happiness for people as it also was in the Danish survey presented in table 1 above. Beside these two surveys, there are numerous research results which show the same importance of recognition. Recognition is one of the central ways to *care for others* in our daily life regardless in organisational or family contexts. Even though there are such obvious indications for the importance of recognition, it seems that to recognize others is one of the most difficult behaviours to practice. To recognize others are particularly important for those who are in leader positions. Too many managers seem to have forgotten *the power of recognising* their people when they have done a good job. In case after case we have seen, that this is one of the biggest gaps when we measure leadership performance in relation to people's needs.

Care for the organisation and society can be understood as an extension of care for oneself and care for others. Besides of those elements important for caring for oneself and others, organizational factors have to be considered. Due to the organizational factors such as organizational goals, processes, communication, reward systems, sharing information and other resources, participation, involvement and empowerment, innovation etc. leadership becomes a critical aspect here.

Peters and Austin's simplified organizational excellence model (1985) illustrates well these issues. They regarded excellence as being the result of the following 4 critical success factors:

1. *PEOPLE*, who practice
2. *Care of CUSTOMERS* and
3. *Constant INNOVATION*.
4. *LEADERSHIP* which binds together the first three factors by using *MBWA* (Management by Wandering Around) at all levels of the organization.

This simplified excellence model indicates that care is not an end in itself but rather a means to the end which here is building a company culture characterized by *constant customer focused innovation.* But that is only possible if care is related to both customers and to the organization's people in a balanced way. What's needed is that the people work together towards a *shared vision* which is rooted in people's *personal visions and goals*. To build a shared vision requires care for people. Another name for *people care* is *respect for people*

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which together with *continuous improvements* are regarded by Toyota to be the secrets or the DNA of Toyota Production System (Dahlgaard-Park & Dahlgaard, 2007).
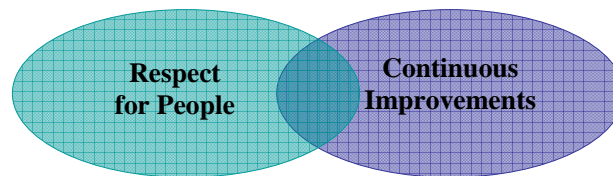
Figure 2: Toyota's DNA

4. Risk more than others think is safe.
Most people may first think about external situations when they see this sentence, but we think that to risk more than others think is safe should be related to all situations.

What is risk? Synonymous to risk are danger, fear, and adventure. When are people taking risks? When are people not investigating whether there are risks or not, before doing something? When are people *not asking* for a guarantee before doing something? Small children do very seldom consider risks when they are doing what they like to do. We call children activities for 'play'. Even though there are obviously great risks with practicing 'Extreme Sports, such as off-road skiing and rock climbing, such sports are very popular. Did we give birth to our children based on the analysis of risk? We seldom consider risks or asking for any kind of guarantee when we fall in love and when we marry with a person we love. In such situations, we feel it's even absurd to ask 'what are the risks'? In such situations, there is no space in our mind to think about risks, because we feel it's so natural *to do it*.

It seems that passion and risk taking are well matching pairs of words. Also it seems that love and risk taking are well matching pairs. When there is passion, people are more likely to take risks. We take also risks when we have confidence. The word confidence in Chinese contains two characters, the first character means 'strong' and the second means 'belief'. From these observations we find some co-relationships between confidence, passion and risk taking. Passion and love foster confidence and in confidence risks have no power.
What we find interesting here is that the above mentioned *care for oneself, care for others and care for organizations* are foundations and also the way to practice love and passion and thereby taking risk at micro (individual) as well as macro (organisational and society) levels with confidence.

Organisational risk taking in e*xternal situations* may be related to innovation/ new product & service development or to enter a new market. A more seldom example is the vision created by John F. Kennedy to launch the first man on the moon before the end of the 60s. In all these situations people are working with many unknown and risky factors. They know *what* they want to do, and also *why* but they don't know with certainty *how* to achieve the vision. In other words people are taking risks with confidence and passion in terms of knowing clearly *why to do* and *what to do* and *want to do*. Many of us know that John F. Kennedy's risky moon project succeeded because he succeeded to transfer his and many people's dreams/visions to be a collective dream – a shared vision.

"*Shared vision fosters risk taking and experimentation. ... You know what needs to be done. But you don't know how to do it. You run an experiment because you think it's going to get there. It doesn't work. New input. New data. You change direction and run another*

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experiment. Everything is an experiment, but there is no ambiguity at all. It's perfectly clear why you are doing it. People aren't saying, 'Give me a guarantee that it will work.' Everybody knows that there is no guarantee. But the people are committed nonetheless" (Senge, 1990, p. 209).

Organisational risk taking in *internal situations* related to excellence are concerned with building a shared vision which often has to do with improvement or change in people's attitudes, knowledge, skills and culture. These areas need to be changed before real breakthrough in the results which you deeply wish will happen (Juran, 1964).

Change in people's attitudes, knowledge, skills and culture takes time – often several years - and massive education and training programs are needed, which costs time and money. Many people may think that this is a risky business and often management will hesitate to invest the needed resources in such a project (or process). Management may think that this is an unnecessary and maybe also unsafe investment.

Post Denmark (Dahlgaard & Dahlgaard-Park, 2004) is a good example of a company which was in a deep crisis in 1997 but managed to change the negative trend and attained excellence after about 5 years work with the principles, tools and methods of TQM. Post Denmark's top management team took, as many would express it, a huge risk when they decided to start up the most massive training program ever seen in Denmark. During 18 months, starting in the beginning of 1998, all 30,000 employees were trained in order to participate in the change program called TIQ (Total Involvement in Quality).

The company succeeded within a few years to change people's attitudes, knowledge, skills and the company culture. Improvements in performance results such as employee turnover, employee absenteeism, employee satisfaction, the quality of deliveries and the financial results were attained. The negative trend in several results was stopped and reversed to a positive trend. The managers' mental models of the situation were dramatically changed to the positive, and at the end of 1999 Post Denmark received the Danish Human Resource Award for their committed attention to improving the working conditions for their employees. A main cause for receiving this award was that Post Denmark from the start of their quality journey regarded the people dimension as the area, which should be improved first. It was from the beginning understood that a good quality improvement strategy to follow was *the "4P" strategy*. Post Denmark is now recognised as being maybe the best run Post Office in Europe with the highest customer satisfaction among European Post Offices. The company received in 2004 the Danish Quality Award and in 2006 the EFQM Excellence Prize. The company's profit was in 2006 all times high. Maybe that was the main cause for Swedish Post for accepting to merge with Post Denmark, April 2008.

Time will show if this merge between two companies with different cultures and different understandings about excellence will become a success or if the risk was too high. Here the new top management team has a special responsibility to understand and to control the risk of destroying the new company culture (the TIQ Culture), which took Post Denmark about 3-5 years to build. Experiences from several other merges tell us that such a culture can be destroyed in weeks, and if this happens the new company will not have success. The risk taken may only be safe if the new top management team (with a Swedish CEO) can agree on *learning from the best*, which in this case seems to be Post Denmark (*little brother*).

5. Dream more than others think is practical.

The importance of dreams can be found richly both in classics and modern literature. An example reference can be found in the Book of Proverbs of the Christian Bible's Old Testament where you can read the following about dreams:

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"A People without dreams will perish".

This statement supports the importance for any person, group, and organisation to have visions – dreams to be better and have a better situation for the family, the organisation, and the country or maybe the planet called earth.

Understanding the power of dreams may be important for developing new attractive products and services. Attractive Quality Creation (Kano, 2001) and the roots for future excellence may lie in meeting products that are dreams of customers. To properly do that, managers of corporations will in the future have to learn grasping the minds of customers, meaning that they may have to understand customers better than customers understand themselves. An example of a company vision related to new product development follows below.

In 1998 the author of this article was involved in a transformation process in Pioneer Denmark (Dahlgaard & Dahlgaard-Park, 1999). The background of the transformation process was that Pioneer Electronics had competition problems on the world markets especially with the other two Japanese competitors – Sony and Matsushita Electronic Corporation (Panasonic etc.). To start a transformation process aiming at changing the image of Pioneer and its product branding the president of Pioneer gave a New Year speech to top managers from Pioneer companies all over the world. In this New Year speech he announced Pioneer Electronic Corporation's new corporate identity which at the same time was announced as the corporation's *Vision 2005 - Move the Heart and Touch the Soul.*

The vision was presented with a tree metaphor picture as shown in figure 3 below.
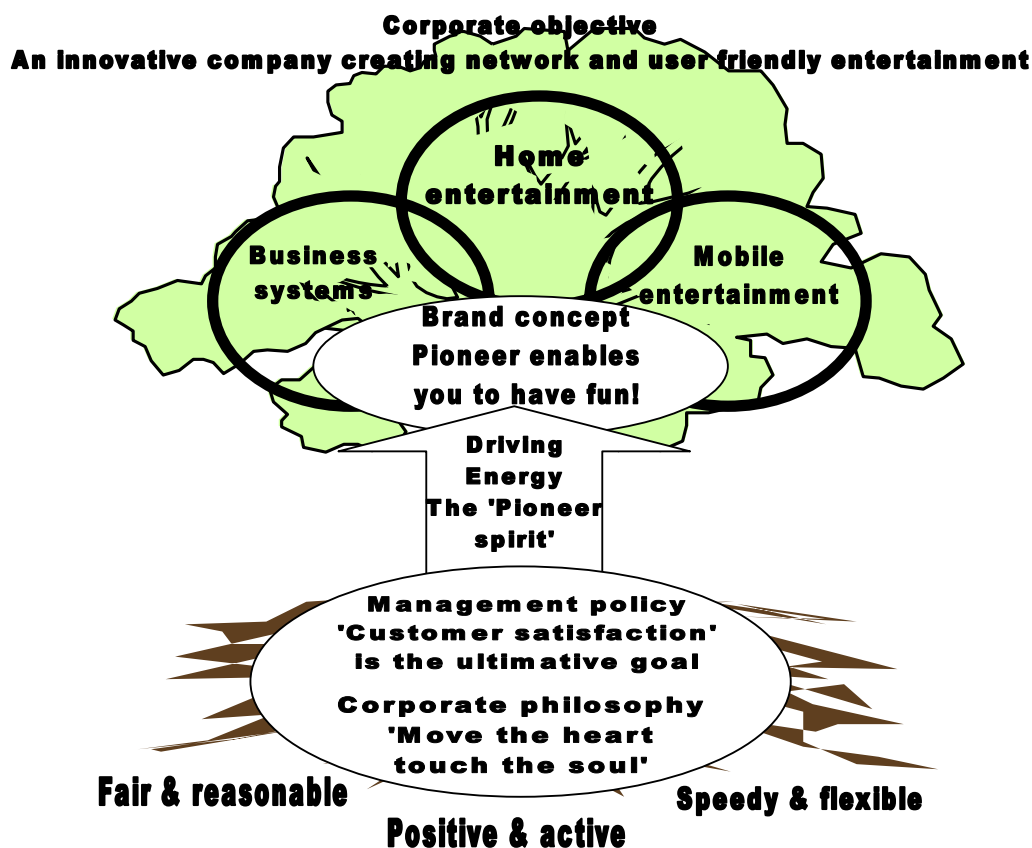
Figure 3: Pioneer Electronic Corporation's New Corporate Identity (Vision2005)

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'The key message from Pioneer's president was that all efforts from companies and employees all over the world must now be focused on the goal - *customer satisfaction is our ultimate goal*. But this ultimate goal can only be achieved if employees all over the world in their different jobs participate actively in understanding the different dimensions of customer needs and problems. Having understood the variation, interdependence and depth of customer needs then people can begin to design new products which may be able to *"Move the Heart and Touch the Soul"*. People may gradually understand that attaining such a state requires that the customers will have positive experiences related to sensing, cognition, morality, action, or social relations. All these experiences will together determine if the product will "move the heart and touch the soul".

From figure 3 we can see that the drivers of the "Pioneer Spirit" are the management policy "Customer satisfaction is the ultimate goal" and the corporate philosophy "Move the Heart and Touch the Soul", which together are supported by the company's core values "Fair & Reasonable", "Positive & Active", and "Speedy & Flexible".

Such a company vision supported by a corporate philosophy and a management policy can be very effective in creating visions and goals for teams and individual employees. This is the critical phase where an existing company culture may have to be changed to a new and participative culture characterised by "respect for people" and "continuous improvements" (see figure 2). You cannot command such a culture. If you do that you may spoil relationships between management and employees and you will not be able to release the full potentials of your people. The result may further be that the employees will have dreams about a better work life meaning that they want to find a better job in another company – maybe a competing company.

6. Expect more than others think is possible.

Expectation is closely related to the previously discussed concepts of care, risk and dream/hope. If we don't care we don't risk, we don't dream/hope and we will have no expectations. In a healthy and profound personal relationship, expectation is an indication for trust, care and dream/hope.

We have plenty of stories where a person's success was a result of expectation from someone, often parents or a teacher. One of the most successful young photographers in Singapore declares that his success is due to the expectations of his father. Expectations with many years true care for his son, trust, patience and dreams/hope even though most people gave up their expectations on him because he was a very poor student. Expectation is withy other words a declaration of care and trust.

Konosuke Matsushita, the founder of the world's largest consumer electronics company, teaches us what it means to expect as a leader and reminds us that trust and expectations are two sides of the same coin:

"Yet, I can't resist the temptation to say that I was well aware of the crucial importance of human relations in corporate setting even in the early days of my business career. Granted, my approach is intuitive, and my knowledge is experiential. But my instinct, and perhaps my conscience, dictated to me that I should trust my employees if I expected them to trust me. I must have full confidence in their ability to learn and their potential for personal growth. Only then would the employees have full faith in my managerial competence and personal integrity" (Matsushita, 1989).

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As is clearly expressed by Matsushita, expectation not only requires trust and care, but also risk taking without asking for guarantees.

A large survey in the 90s in US where 100,000 employees were asked about what in their opinion were the most critical motivation factors for their job motivation. Parallel with that 25,000 leaders were asked about what they perceived or expected to be their employees' most critical motivation factors. The results of this survey are shown in table 4 below.

It follows from table 4 that employees' top 3 was equal to the bottom 3 of leaders' perceptions, and it is also seen that the leaders had good salary as the first priority while employees had good salary as the 5th priority. There seems to be a huge contrast between the survey carried out in US and Matsushita's view on employees.

Our experience based on 20 years of research and consultancy in Quality Management and Organizational Development (QMOD) is that this picture is also common in Europe and Asia. High expectation is coming from high respect, trust and believes and that requires high risk taking and patience.

Table 4: Most Critical Motivation Factors? (100.000 employees & 25.000 leaders - in USA)

Employees' priority	Critical Motivation Factors	Leaders' perception
1	Values of my work	8
2	One's effort is recognized	10
3	Get a support when having personal problems	9
4	Job security	2
5	Good salary	1
6	Interesting work	5
7	Rewards and development	3
8	Organisation is loyal	6
9	Good physical working environment	4
10	Discipline	7

To have success with any kind of change, improvement programs as well as our pursuit of excellence, it is necessary that management listen to and involve their employees. By listening to their employees management often become surprised by discovering that the employees have quite other priorities than they had expected. They may find out for the first time that employees have other needs than salary to satisfy biological or material needs.

The concept of expectations, seen from an organizational perspective, has many dimensions as it may be related to both products/ services as well as to people. The people dimension includes customers, employees and other stakeholders. Matsushita's case is an example of expectations between leaders and employees.

Disney's definition of Quality Service from the beginning of the 90s (Disney Quality Service course material) and their efforts are a good example for discussing customer expectation and how the company understand customer expectations:

> "*Attention to detail and exceeding our guests' expectations:*
> Our guests are considered to be VIPs – very important people and very individual people, too. What contribute to Disney's success is people serving people. It is up to us to make things easier for our guests. Each time our guests return, they expect more. That is why attention to detail and VIP guest treatment is extremely important to the success of the Disney Corporation"

As is mentioned above, when there is expectation, there is also a dream/hope. When people decide to visit one of the Disney amusement parks they have hopes for joy and fun, and

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Disney understands very well that continuous improvements and attractive service quality creation are needed in order to year by year exceed guests expectations. The old paradigm of quality from the 80s saying that quality is to satisfy customers' expectations is definitely obsolete. The new paradigm of the new century is continuously to exceed expectations.

7. Core Values – the Entrance to People Satisfaction and Commitment
Danfoss, one of the biggest industrial companies in Denmark with about 21,000 employees, initiated a research project in 1999 with the aim of identifying the factors that are most critical for people's loyalty and commitment.

The theory behind the research project was the Trinity Motivation Model (Dahlgaard-Park, et al. 1998; Dahlgaard-Park & Dahlgaard, 2003) which explains the driving forces of people motivation. According to the Trinity Model people's action /activities are driven in order to satisfy the three essential human needs – biological/physical, mental/psychological and spiritual/moral needs (see figure 4 below).

Biologic
al needs

Food, water, air, clothes, shelter, warm

Trust, Respect, Honesty, Integrity, Meaning Justice, Sharing

Belonging Recognition Identity, Learning, Achivement

Spiritual needs

Psychologi
cal needs

Figure 4: The Trinity Model of Human Needs (Dahlgaard-Park, 1998, 2003, 2006)
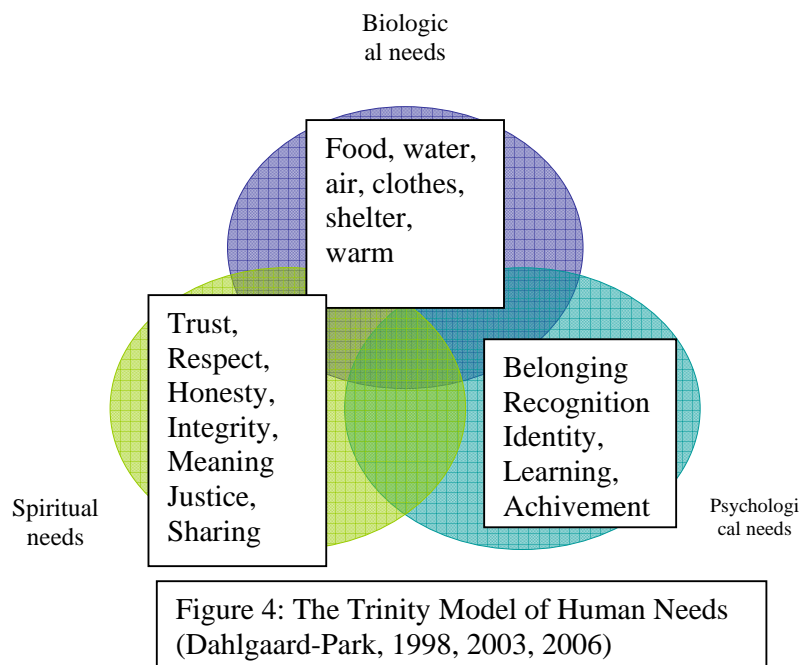
The interactions between these three needs and the way to prioritize some needs more than others vary largely between individual persons and their situations (contingency factors). The way to satisfy these needs vary also largely on individual persons and their situations. In the Danfoss case the two factors of psychological and spiritual needs were tested on how the two factors affect or determine *people commitment in an organizational context.* A hypothetical model was constructed where the following 3 latent variables were supposed to have high effects on creating people motivation, commitment and loyalty in an organizational setting:

1. Practice of *Core Values (behaviors of the spiritual dimension)* by Top Management, Middle Management and Colleagues.

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2. Practice of *Core Competencies (behaviors of the psychological dimension)* by Top Management, Middle Management and Colleagues.

3. People's *Personal Attitudes*.

331 middle managers from 10 different divisions were invited to fill out a questionnaire with 82 questions for evaluating and understanding people commitment (Dahlgaard-Park, 1999; Dahlgaard-Park & Dahlgaard, 2003). The result of the data analysis (using Amos 4 and Lisrel) is shown in figure 4 below.

From the model in figure 4 we see clearly the importance of the Core Value factor. There is a strong direct relation from Core Values to Core Competencies, and through Core Competencies and Personal Attitudes there is strong indirect impact on the result factor Commitment/ Loyalty. Also there is a significant direct relation between Core Values and Commitment. So the model supports clearly the hypothesis that the Core Value dimension should not be ignored when trying to understand people's commitment. The model's degree of explanation was as high as 0.82.

The data analysis showed that if Core Values increased by 1 point then the expected increase on Core Competencies were 0.88 (= the impact score), and the impact score from Core Competencies on Personal Attitudes were 0.57. The impact score from Personal Attitudes on Commitment was 0.72. The figure also shows that the direct impact score from Core Values on Commitment is 0.28.

The empirical finding shown in figure 5 is a strong indication for a hypothesis that management's and colleagues practice of Core Values is the most important for understanding people's motivation and commitment.
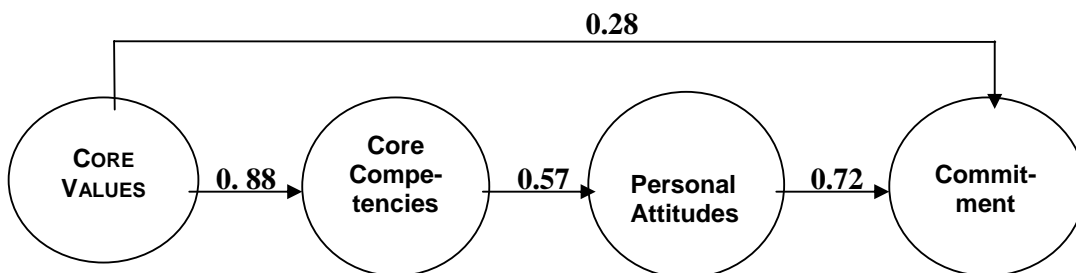
Figure 5: Estimated Model explaining People's Commitment/passion

Practicing Core Values in terms of practicing respect, integrity, fairness, openness of top managers, middle managers as well as colleagues are an expression of practicing Care for others which was the first building block or precondition for attaining excellence.

As values are the social principles, goals and standards held within a culture to have intrinsic worth and as values define and determine what the members of a society / organization care about, making judgments about what is right and what are wrong, values are associated with strong emotions. Value seems to be the ultimate source in the creation of genuine intrinsic motivation.

When people are motivated to do something based on values, the tasks or activities seem to be linked to the person's inner desire. This in return creates a genuine commitment/passion of a 'want to do' attitude instead of 'have to do' or 'forced to do' attitude. Voluntary workers

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in many humanitarian organizations, such as Red Cross, Green Peace and Doctors without Borders are driven by inner desires based on their personal value sets. The recent focus on the importance of a company's vision can also be understood from this perspective.

A Company's vision that is shaped based on a common value set of all employees is a strong 'guiding star' and such a vision in terms of goals, values and missions helps employees in maintaining commitment. Referring to the genuine humanistic approach, which considers *human* as essentially *being worthy*, core values provide a more concrete 'idea' of what it means as core values are also the way to practice the worthiness and the care project of human being.

A very recent Danish survey from 2008 (Sörensen & Christensen, 2008) focusing on the importance of values supports the overall conclusions from the Danfoss Case. In the Danish Survey, called *Talent 2008*, the news magazine *Berlingske Nyhedsmagasin* asked 7,455 academicians below 40 years old about their attitudes and expectations to their jobs, carrier and management. With a response rate of 41%, 3024 respondents answered the survey questions, and 724 of the answers were from respondents with a management position.

The first question reported here is seen in figure 6 below. It follows that among respondents with a management position only 62% reported that they know the company's values, and among non managers only 39% know the company's value set. Even if non managers reported that 56% have a general idea about the company's values it seems that this group has a lower knowledge than respondents with a management position. Overall it seems clear that the knowledge about values is too low in Danish companies. This is a serious problem because practice of a company's values requires first of all knowledge and second understanding. If no knowledge then it is not so easy to understand.
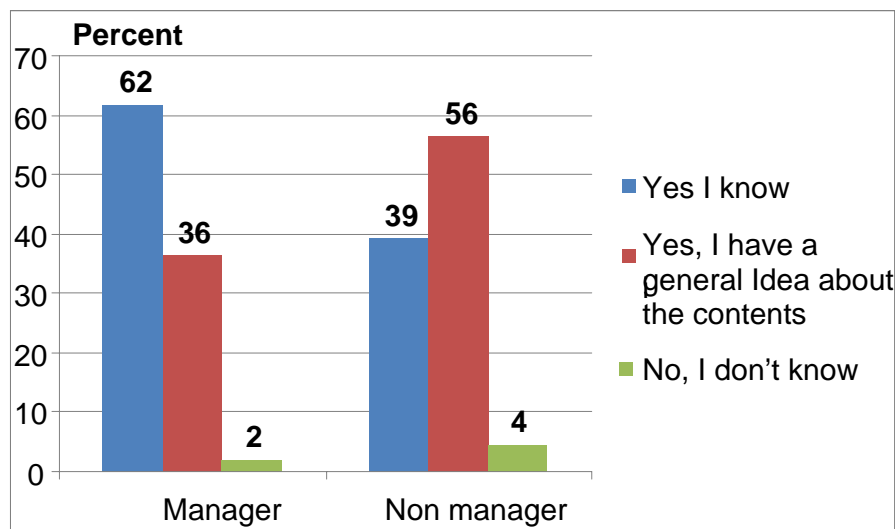
Figure 6: Do you know the contents of your company's value set

The next question reported here is about practicing the company's value set. From figure 7 it follows that both groups – managers and non-managers – almost have the same experiences regarding the practice of values. These results seem very poor. Only 23% of the managers and 19% of the non-managers report that the company's values are practiced to a high degree. But that means about 80% of the respondents have reported that the company's values are not practiced to a high degree. Here we have to understand that values are only "valuable" if they

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are practiced to a high degree. You cannot practice for example respect one day and the next day you do the opposite. The effects of such a bad practice will always be negative. So our conclusion is here that 4 out of 5 Danish companies must improve both the knowledge and the practice of the company's value set.
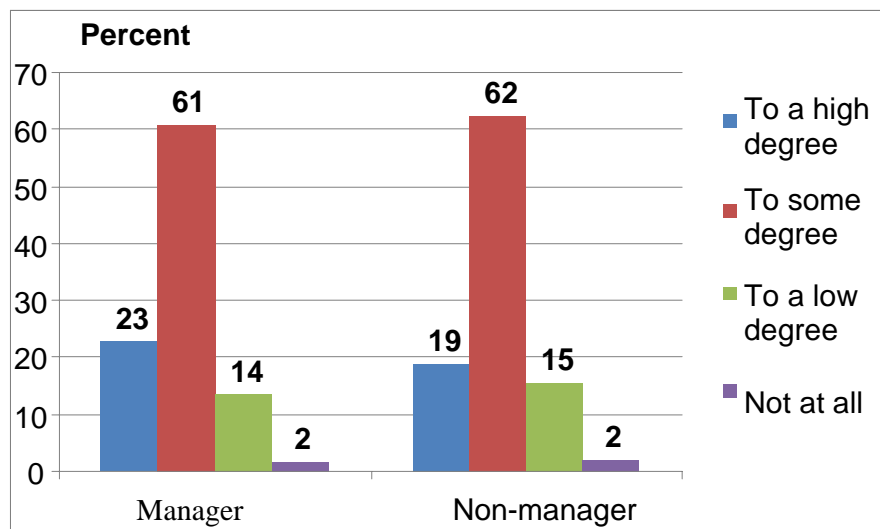
Figure 7: How do you feel that your company/ working place practice the company values?

The results reported in figure 8 show that company values are decisive for about 30 percent of the employees when they are applying for a new job, and further about 50% of the respondents report that it is decisive to some degree. Only 15% of the managers report that it has no importance or is decisive to a low degree, and 21% of non-managers reported the same. So it seems clear that company values and image are important if a company really want to attract the best people.
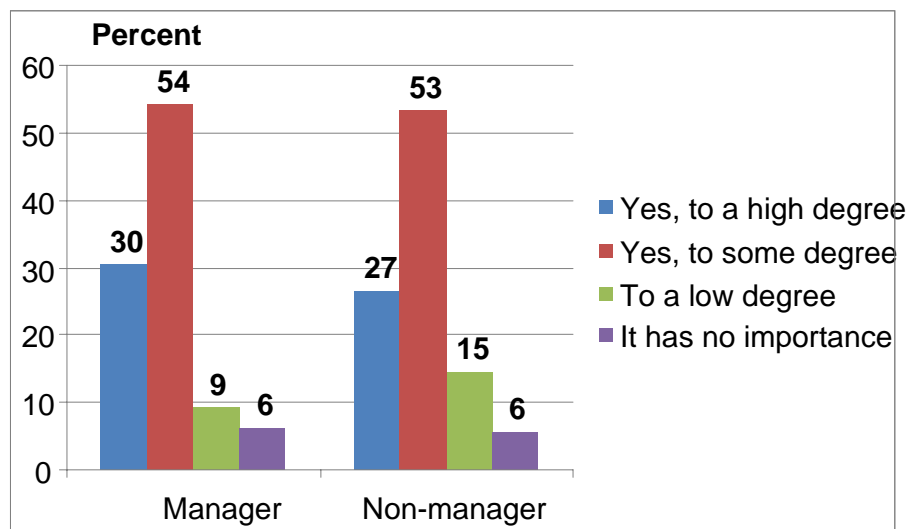
Figure 8: Are the company's values and image decisive when you apply for a job?

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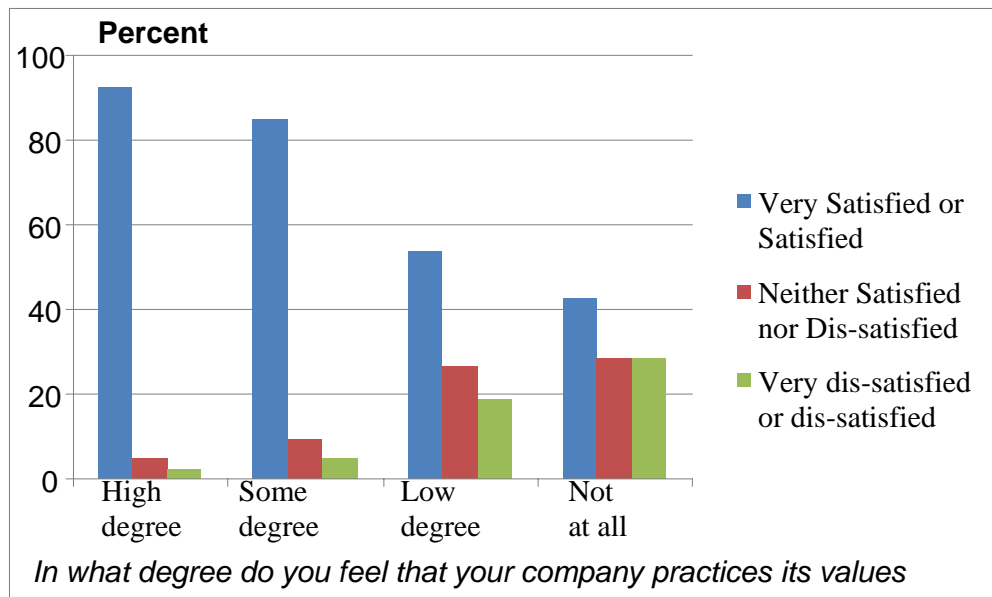
Figure 9: Job Satisfaction in companies which practice their values at different degrees

From figure 9 we can see that job satisfaction correlates positively with how well the values are practiced. In companies which practice the company values to a high degree more than 90% of the respondents reported that they were very satisfied or satisfied with their jobs. This percentage is still high – and at a surprisingly high level of more than 80% - when companies practice the values to some degree. When companies practice the values to a low degree we can see that only 54% of the respondents were very satisfied or satisfied with their jobs. Only 43% of the respondents were very satisfied or satisfied in companies which did not at all practice core values. That means 57% were dissatisfied or neither satisfied nor dissatisfied when companies did not at all practice the value set.

By combining the results from the Danfoss case with the recent results from the big Danish questionnaire study the following overall conclusion is drawn:

Practicing Core Values is the Entrance to People Satisfaction and Commitment.

If companies really want to attract the best people and if they want to have committed and satisfied employees they have to use resources for discussing, defining and deploying/ practicing core values. That is an important precondition for building sustainable excellence.

8. Reflections and Overall Conclusions
In the article I tried to 'decode' by elaborating, interpreting and discussing 'the code of excellence' in order to discover the hidden meanings and complexities and further to identify relationships between wisdom and scientific knowledge developed for understanding excellence.

After having gone through from the definition of excellence (section 2) 'the code elements' were discussed in sections 3-6. Section 7 supplemented with extracts of a Danish case – the Danfoss case as well as the recent large survey - examples of creating commitment, a passion which is one of the most critical building blocks for attaining excellence. Practicing

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Core Values in organizational level can be seen as a care project for people and society in a broad perspective.

The final reflections and conclusions based on the research documented in this article are related to what was written in section 2 about excellence:

> Excellence includes doing common, everyday things and excellence isn't necessary determined by comparing a score or a performance to someone else. The pursuit of excellence comes from doing our best with a view of growing and improving in terms of realizing one's potential. When we care more, risk more, dream more and expect more while doing everyday things, we are on the way to realize our potentials. It is a never ending journey. Excellence is not a stage, but a way of doing, way of living, a process of becoming. If our today is better than yesterday, we have realized a small amount of our potentials and we can further dream on and work on for a better day tomorrow.

By relating excellence to "doing common, everyday things" it is emphasized that excellence has meaning in any context – personal, organizational, social and even global contexts.

In any business context pursuing excellence is vital, and it is important to emphasize that an excellent organization is a result of people's continuous pursuit of excellence. Everybody is trying to *doing their best when doing common as well as uncommon everyday things with a view of growing and improving in terms of realizing one's full potential.*

During the work with this article I became more and more aware about the profound meaning and complexities which the code possesses. The logical depth of a statement is an expression of meaning, value and complexities which the statement possesses (Bennett, 1986). Meaning and complexities are expressions of 'production processes' rather than the result product. Logical depth and thereby meaning and complexities are created by the time where exformation processes have taken place. Exformation is information which are sorted and thrown away. The more exformation has taken place, the deeper meanings and complexities have been created.

The code of excellence has shown that with its few sentences it has profound meaning and complexities – the logical depth. The logical depth in terms of profound meaning and complexities are created by our ancestors who repeatedly practiced, refined and sorted out unnecessary information (exformation) and finally sent us the most critical message in a most economic way. In this article I have just begun to decode the code of excellence, and it is clear that if I shall decode the code fully, thousand of pages will be needed to explain the full meaning of each sentence and the complexities among others the interaction of the different building blocks.

Also it has been found that the code of excellence is well matching with the scientific knowledge elaborated and developed under the theme of excellence. Previous research could be related easily to the code of excellence without any conflict. Regarding the relationship between wisdom and scientific knowledge, I may say here that wisdom is collectively internalized and verified knowledge throughout human history, while the large part of scientific knowledge is externalization (exploration) of the internalized knowledge.

Based on these reflections, I would conclude this article with the simple model shown in figure 10 below. I am more convinced than before, when discovered and firstly reflected on the embroidery text at the fish market, that the text contains critical DNA for attaining excellence, which fully live up to the name given in this article – the Code of Excellence. We cannot ignore the strong message our ancestors have sent us – we have to practice it through our life, and send the message further to our children.
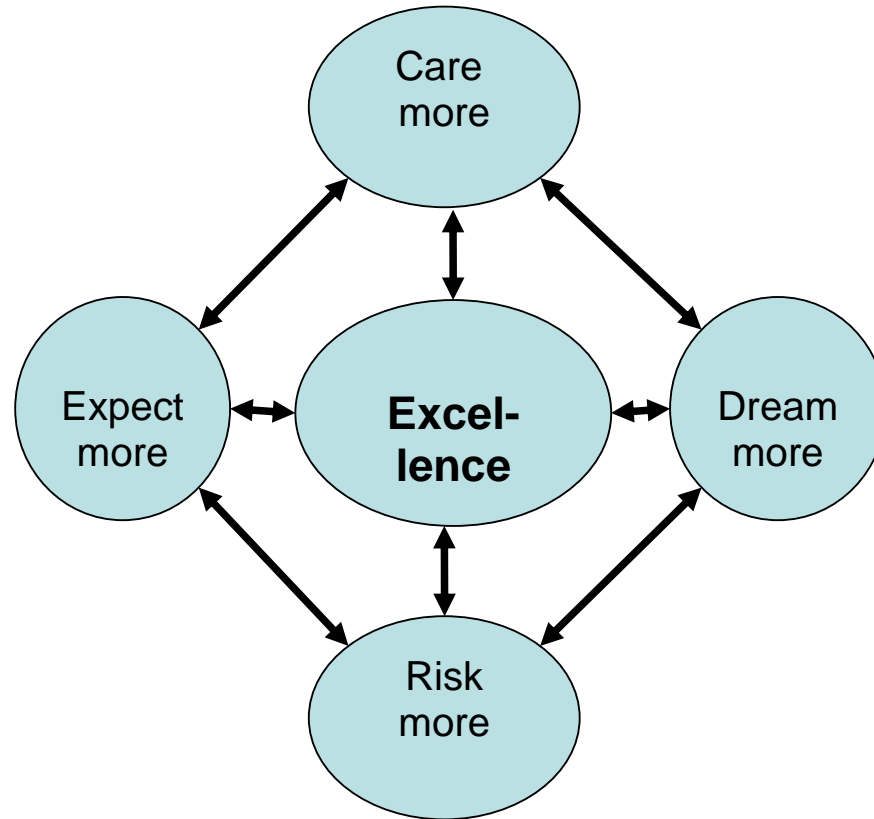
Figure 10: Critical Success Factors in the Pursuit for Excellence

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Quality Engineering for Early Stage of Environmentally Conscious Design

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Abstract

Purpose – This paper proposes application of quality engineering in the early phase of environmentally conscious design (Ecodesign).

Methodology/approach – Utilizing Kano Model and willingness to pay, it presents a framework for classification of environmental characteristics of products/services (i.e. offers) in two dimensions. The framework is connected to design management, i.e. design itself and external communication, where strategies for companies are given. The integration of the classification and the strategies is applied to three environmental characteristics against Japanese markets.

Findings – The classification framework was proved to be effective as it generates much richer implication than other existing methods. In addition, it works well especially for environmental characteristics. Generation of strategies was also found to work effectively. They suggested some potential of using quality-engineering oriented methods/tools to deal with customer perception in the early phase of Ecodesign.

Research limitation/implication – The results imply the needs for research on further utilizing quality-engineering approach and methods in the early stage of Ecodesign. This would be effective as how customers perceive offers has been neglected in the research and practice of Ecodesign and the focus of Ecodesign has been rather in its technical aspects. This research, in a broader sense, exists in integration of marketing and design disciplines.

Originality/value – This paper has brought light into the arena where customer aspects in Ecodesign are addressed and has proved some potential for quality-engineering approach and method to tackle the aspects.

Keywords – Kano model, design management, offer development, communication to customer, willingness to pay, sustainability.

Paper type – Research paper.

1. Introduction

Environmental problems such as the global warming problem (IPCC, 2001) and the waste processing problem (OECD, 2001) have been quite serious over a couple of decades. Thus, it is recognized that our society at present is not environmentally sustainable. In fact, companies are required to decrease environmental impacts caused by their products/services while they compete in their markets. To do so, designers/developers play a crucial role; the environmental impacts are determined mainly by design. The activity required for designers in this context is called Ecodesign (environmentally conscious design), which is defined in this paper as "design activity reducing the environmental impacts throughout the life cycle of a product with conforming the market".

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One problem of current Ecodesign (Fiksel, 1996; UNEP, 1997; Karlsson and Luttropp, 2006; Rahimifard and Clegg, 2007) consists in difficulty to embed competitiveness on products or services just by following current Ecodesign methods as is suggested by (Stevels, 2005). Many of the environmental properties of offers, i.e. products or/and services, which those methods support to be implemented are becoming established as part of regulations or legislations that for manufacturers must comply with. Thus, current Ecodesign methods support manufacturers to satisfy necessary conditions but not sufficient conditions so as to obtain competitiveness in their markets. I.e. they help companies with be *defensive*, but not be *offensive*. In the business world as well, how to raise competitiveness with environmental consciousness is becoming a hot issue, since environmental consciousness could be a killer content (Anonymous, 2007).

To be *offensive* in Ecodesign business, a company should understand what kinds of environmental characteristics contribute to the economy. (Note that an environmental characteristic in this article means the characteristic making meaningful distinction as such to other alternatives from environmental aspects. For instance, consuming less energy by a product and using recycled materials in a service are environmental characteristics.) However, the *defensive* aspect of Ecodesign should not be forgotten: There are quite a few environmental properties that must be implemented according to standards or regulations as described above. Furthermore, it is a fact that there is a *softer* aspect as well that companies have in mind: Even without a hard number, i.e. economic performance, per a product or a service, some companies decide they should fulfil Ecodesign. This may be due to their belief that Ecodesign contribute to establishing their corporate branding. Thus, an integrated view of the *offensive* and *hard,* the *defensive,* and the *softer* issues in relation to environmental characteristics is needed.

This challenge cannot be tackled by addressing only product design. The three issues addressed in the previous two paragraphs lift us to the world of design management, where the parameters to be controlled exist in how to design their offers as well as how to communicate the offer properties to the customers. This research tackles how to manage Ecodesign in a company keeping the three issues in mind. Quality engineering has big potential to do so, as it can address competitiveness of products/services and the perception by customers.

As a first attempt to prove the potential of quality engineering in Ecodesign, this paper proposes a framework for classification of environmental characteristics of offers after (Sakao and Fargnoli, 2006; Sakao, 2008) based on Kano model and willingness to pay. The framework is connected to some design strategies which are also described in this paper. This method, i.e. integration of the classification framework and the design strategies, is applied to three typical environmental characteristics against Japanese markets. The results obtained from the method are discussed for verification. Finally, some future research implications are also presented.

2. Framework of classifying environmental characteristics

2.1. Framework

Figure 1 depicts the overview of the framework. First, this framework introduces simply 1. "how customers feel" and 2. "how customers respond". The latter here specifically means how their willingness to pay (WtP) is. WtP in this article is represented by the amount of money that customers value and would pay for given environmental characteristics. On the

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other hand, it also distinguishes the targets for the customers to feel on or respond to; either the specific offer (product or/and service) or the company providing the offer.

In order to obtain the information for each combination of the elements in Figure 1 from each customer in a systematic way, several structured methods are adopted as shown in Table I. Thus, the proposed framework tells to which class a given environmental characteristics for a concerned customer belongs in each of the four types of the customer's activities; feeling on the offer, response to the offer, feeling on the provider, and response to the provider.

*Consequence & Reason for Requirement
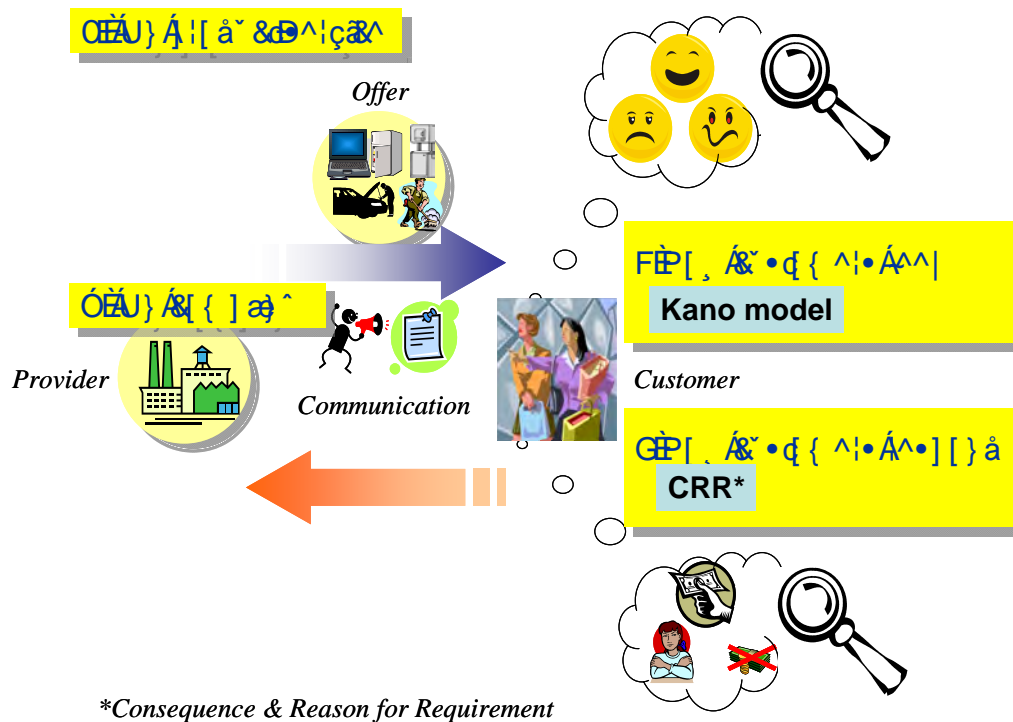
Figure 1. Viewpoints introduced for classifying environmental characteristics

First, Kano model (Kano, Seraku, *et al.*, 1996), which is widely utilized in case of addressing quality for such a purpose, is adopted so as to obtain how customers feel on a specific offer. This allows us to reveal whether the environmental characteristics belongs to an indifferent, attractive, one-dimensional, must-be, or reverse one (denoted as *I, A, O, M,* and *R*). Additional advantage of utilizing Kano model is the predictability on evolving of the class for a customer towards the future. As suggested in (Miyagawa, 1990) and (Finster, Eagan, *et al.*, 2001), the trend of evolving of the class of a characteristics for a given person is; indifferent → attractive → one-dimensional → must-be. Regarding feeling on the company, Kano model is extended just through changing the targets.

As regards the response, a newly developed method for classifying environmental characteristics called the Consequence & Reason for Requirement (CRR) method is adopted. The CRR method is considered to be a method as it is associated with questionnaire and how to process the answers as shown in Section 2.2. The CRR method first discovers whether the environmental characteristic belongs to any of the following four classes. The first class is *compliance* (*c*) with law or regulation. The second one is termed *need* (*n*) meaning what they pay some money for. The third one called *want* (*w*) is what they want but do not pay any money for. The last is for the rest, being called *indifference* (*i*). The discrimination between the second and the third ones originates from such criticality in Ecodesign as pointed out in

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(Sakao and Fargnoli, 2006). In addition, the CRR method reveals the reason why they *need* or *want* the concerned environmental characteristics. This information is crucial for how to communicate the characteristics to the customers.

Table I. Adopted methods and their classes

	1.How customers feel	2.How customers respond
A. On offer (product/service)	Kano model: Indifferent, Attractive, One dimensional, Must-be, Reverse	CRR method: Compliance, Need (& Reason), Want (& Reason), Indifference
B. On company	Extended Kano model: Indifferent, Attractive, One dimensional, Must-be, Reverse	CRR method: Compliance, Need (& Reason), Want (& Reason), Indifference

2.2. Questionnaire developed to identify the classes within the framework

The questionnaire is designed to grasp the class for the four types of information, and is in more detail described below.

Questions for A-1; feeling on the offer

The same questions as in the original Kano method (Kano, Seraku, *et al.*, 1996) are adopted.

Questions for B-1; feeling on the provider

The difference with the questions in the original Kano method is the target which customers feel on. The target is the company who provides the offer. One of the two questions is:

> How do you feel on the company if the company provides a product (has a product line) with the concerned environmental characteristics?

Questions for A-2; response to the offer

The questions are designed so that they capture the needed information as precisely as possible. Thus, they assume a buying situation where customers compare two offers. The format of the questions is:

i) Which offer do you purchase, a or b? Offer a has the concerned environmental characteristics while offer b does not. Choose one from the followings.
  1) Purchase offer a, if its price is higher than that of offer b but the difference can be accepted.
  2) Purchase offer a, if its price is equivalent to that of offer b.
  3) Purchase the offer with a lower price.
  4) Purchase offer b, if its price is equivalent to that of offer a.
  5) Purchase offer b, if its price is higher than that of offer a but the difference can be accepted.
  6) Others.

ii) What is the reason for i)? Choose one from the followings.
  1) It contributes to solve the environmental problems.
  2) It is beneficial for me.
  3) Others.

Answering 1), 2) and 3) to the question i) is understood so that the answerers consider the characteristics to be *need*, *want,* and *indifference*, respectively. Answering 4) and 5) to the question i) means that the characteristics influences the answerers negatively. Answering 1) and 2) to the question ii) shows that the reasons of the answerers are environmental and non-environmental, respectively.

Questions for B-2; response to the provider

The difference with the questions for A-2 is the target customers feel on. The target is the company who provides the offer.

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3. Design-management strategies

This section briefly discusses the newly introduced strategies taken by a company according to the classification regarding the perception of an offer. The strategies are intended for both development and communication within a company as proposed in (Sakata and Suzuki, 2007). Therefore, these strategies are beneficial for design management, rather than product-design strategies in a narrow sense. Table II shows some orthodox strategies depending on the Kano classes, whilst Table III presents strategies according to the CRR classes. It should be noted that this paper focuses more on development issues rather than communication as well as the offer rather than the company as a whole. Thus, this section discusses strategies only on an offer with focus on development.

For instance, a must-be characteristics, as shown in Table II, should be implemented, while it should not be appealed to be efficient in communication since customers take its implementation for granted. Table III shows that the development team should deal with a *need* depending on its importance to the customers and its cost. On the other hand, a *want* should be incorporated and treated only when no critical impacts are available.

Table II. Strategies suggested from the Kano classes

Kano class	Development	External Communication
Attractive	Implement depending on importance & cost.	Do appeal if implemented.
One-dimensional	Enhance depending on importance & cost.	Appeal quantitatively.
Must-be	Do implement.	Do not appeal.
Indifferent	Do not implement.	With contents in causes/effects or metaphor if wanted.

Table III. Strategies suggested from the CRR classes

CRR class		Development	External Communication	
Compliance		Implement.	Communicate only the compliance in case of customers' attention.	
Need	Non-env.	Implement/enhance depending on importance & cost.	In language of receivers' benefits.	High priority
	Env.		In language of environment's benefits.	
Want	Non-env.	Implement/enhance only with no critical impact on costs, etc.	In language of receivers' benefits.	Low priority
	Env.		In language of environment's benefits.	
Indifferent		Do not implement.	With contents in causes/effects or metaphor if wanted.	

4. Application of the classification

The classification has been applied to three typical environmental characteristics on Japanese markets. The questionnaire was fulfilled in August 2007 against 1,000 persons living in Japan. They consist of 10 groups each of which is composed of 100 persons who are characterized by the age, gender, and occupation. The three environmental characteristics are as follows.

1. energy-saving performance in a refrigerator
2. adoption of hybrid engine in an automobile
3. adoption of plant-based plastics in a chassis of a notebook-typed PC (personal computer)

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It should be noted that explanation for each environmental characteristics was given to the answerers such as what a hybrid engine is. It was also pointed out that the strength of the concerned plant-based plastics of the PC is equivalent to that of other types of plastics normally used in a PC.

Table IV. Percentage of answerers on the offer: Businessmen (males) over 50 years old

1. energy-saving performance

Kano \ WtP	I	A	O	M	tl.
n	5	2	9	14	30
w	20	16	12	9	57
i	6	0	0	0	6
tl.	31	18	21	23	

2. hybrid engine

Kano \ WtP	I	A	O	M	tl.
n	4	15	9	5	33
w	17	25	4	3	49
i	6	0	0	0	6
tl.	27	40	13	8	

3. plant-based plastics

Kano \ WtP	I	A	O	M	tl.
n	3	3	5	3	14
w	26	22	4	7	59
i	18	0	0	0	18
tl.	47	25	9	10	

Notes for Tables IV to VII:
"tl." means total.
Unit; percentage
Legend;

The largest share	The second largest	The third largest

Table V. Percentage of answers on the offer: Housewives over 50 years old

1. energy-saving performance

Kano \ WtP	I	A	O	M	tl.
n	7	7	21	8	43
w	16	14	10	6	46
i	4	0	0	0	4
tl.	27	21	31	14	

2. hybrid engine

Kano \ WtP	I	A	O	M	tl.
n	7	12	15	3	37
w	19	22	1	9	51
i	4	0	0	0	4
tl.	30	34	16	12	

3. plant-based plastics

Kano \ WtP	I	A	O	M	tl.
n	5	5	6	4	20
w	21	27	9	4	61
i	8	0	0	1	9
tl.	34	32	15	9	

Table VI. Percentage of answerers on the provider: Businessmen (males) over 50 years old

1. energy-saving performance

Kano \ WtP	I	A	O	M	tl.
n	1	4	3	1	9
w	13	11	10	16	50
i	15	0	0	10	25
tl.	29	15	13	27	

2. hybrid engine

Kano \ WtP	I	A	O	M	tl.
n	1	5	7	1	14
w	13	15	8	10	46
i	17	0	1	2	20
tl.	31	20	16	13	

3. plant-based plastics

Kano \ WtP	I	A	O	M	tl.
n	1	4	3	1	9
w	14	16	4	13	47
i	25	0	0	2	27
tl.	40	20	7	16	

Table VII. Percentage of answers on the provider: Housewives over 50 years old

1. energy-saving performance

Kano \ WtP	I	A	O	M	tl.
n	4	3	7	5	19
w	8	18	22	14	62
i	6	0	2	2	10
tl.	18	21	31	21	

2. hybrid engine

Kano \ WtP	I	A	O	M	tl.
n	4	4	7	6	21
w	10	24	15	10	59
i	6	0	2	1	9
tl.	20	28	24	17	

3. plant-based plastics

Kano \ WtP	I	A	O	M	tl.
n	3	7	5	2	17
w	9	26	13	12	60
i	12	0	1	0	13
tl.	24	33	19	14	

Tables IV and V show a part of the results of the questions A-1 and A-2; the former table from businessmen and the latter from housewives of the same age range (over 50 years old). The part of reason in CRR is omitted so that only the WtP information is shown from the results of CRR. It is relatively clearly shown in Table IV (3.) that adoption of plant-based plastics in a chassis of a notebook-typed PC for the group is indifferent (*I*, 47%) and it is need (*n*, 14%) for a small portion. The hybrid engine is attractive (*A*) for the majority either in the

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men (40%) and the women (34%) (see Table IV (2.) and Table V (2.), respectively). Over 30 % find positive WtP on the hybrid engine, i.e. regard the hybrid engine as need (*n*), either in the men (33%) and the women (37%). The energy-saving performance is one-dimensional need (*On*) for the most (21%) in the women (see Table V (1.)).

From Tables IV and V as a whole, it may be interpreted commonly for the two groups that energy-saving performance, hybrid engine, and plant-based plastics in this order are regarded as characteristics more of *M* side as opposed to *I*. This is in line with the maturity of the characteristics on the markets. Regarding the WtP, there is distinction between the plant-based plastics and the rest: Relatively fewer people have positive WtP on the plant-based plastics.

Tables VI and VII show the results of the questions B-1 and B-2 in the same format as Tables IV and V. From Tables VI and VII as a total, the same interpretation as from Tables IV and V, i.e. from the offer, holds true that energy-saving performance, hybrid engine, and plant-based plastics in this order are regarded as characteristics more of *M* side commonly for the two groups. Regarding the WtP, there is no distinction among the three characteristics either for men or for women, except for the hybrid engine for the men. This may be caused by bias from an easy link between a hybrid engine and Toyota. This implies that the positive effect on a corporate branding in terms of WtP is independent of the concerned characteristics and the product, but depends on the concerned customer group. The independence is quite reasonable since the payment is not intended for the offer with the characteristics, but for the offer without the characteristics provided by the company.

5. Discussions

5.1. Validity of the classification

As demonstrated in Section 4, the classification was proved to be effective because, first of all, it generates much richer implication than other existing methods. This reveals both the quantity and the quality of the importance on characteristics. It is evident, for instance, if compared to quantitative weighting (scoring) of the importance on characteristics, which is a most-widely adopted method. In the field of Ecodesign method, Bovea and Wang have addressed WtP (Bovea and Wang, 2007), however they fail to handle the quality part. Conjoint analysis (Green and Srinivasan, 1978) is helpful to grasp the WtP, however it cannot discriminate clearly between *need* and *want*. The proposed classification method is powerful especially for environmental characteristics, since it gets hold of *want* whose share is high for environmental characteristics in general. It should be noted that environmental characteristics are wanted for many people but are not worthwhile to pay for as revealed in Section 4. On the other hand, Kano model is among the few methods that can reveal the quality of the importance. However, Kano model has a disadvantage that it shows no information on the consequence of the customers, i.e. whether they will pay some money or not. Thus, the CRR method compensates for it.

From the questionnaire results, it has been found that no class is dominant throughout the different characteristics while considerable difference exists among the different characteristics. This means that the method can work as a good indicator.

At the same time, it must be pointed out that the Indifferent (*I*) of Kano has much higher percentage than the indifference (*i*) of CRR in every characteristic as shown in Tables IV and V when asked regarding an offer. This is considered to be influence of how the questions were described. The biggest difference between Kano and CRR is existence of an offer to be compared with: The question of Kano asks only on the concerned offer, whilst that of CRR

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asks with comparison to another offer. Since the latter imposes answerers severer decision, it is more likely to catch fewer people with indifference.

5.2. Validity of integration with the strategies

The proposed set of strategies in conjunction to the classification generates the followings. In case of energy-saving performance in a refrigerator for housewives over 50 years old, for instance, the development strategy is to enhance depending on importance and cost whilst the communication one is to appeal quantitatively. On the other hand, plant-based plastics in a chassis of a notebook-typed PC for businessmen over 50 years old cannot be recommended to be adopted within the development team. Thus, these were also found to work effectively. However, it should be emphasized that those strategies are quite orthodox and are focusing only on a specific offer. A company can make a different decision rationally: For instance, a notebook-PC provider can reasonably adopt plant-based plastics in the chassis for those businessmen by focusing on the specific segment with the *need* (14%; see Table IV (3.)) in the group. The company could also remark the positive effect on its corporate branding (9% of the group find positive WtP on a PC offered by the company even without such environmental characteristics; see Table VI (3.)).

5.3. Representation of the results from the questionnaire

Figure 2 shows a chart developed to represent the results from the questions A-1 and A-2 (and B-1 and B-2) given an environmental characteristics on a certain group of people. For simplification, the *reverse* of Kano model and the *compliance* of CRR are omitted. This makes twelve combinations from the four classes of Kano model and the three classes of CRR (as shown in Tables IV to VII), each of which has a share of people. In Figure 2, the four classes of Kano model are placed from the first to the fourth quadrant according to the evolving order explained in Section 2.1. The three CRR classes are located from the centre to the outer skirt according to the order; *indifference*, *want*, and *need*. The size of each blob represents that of its share.

Though not the major issue of the paper, this image is quite helpful for a company to manage their design in a middle or long term as well. One of the thick arrows shows the generally acknowledged evolving of the Kano classes, while the other horizontal one may be wished by the company considering the money to be earned. For instance, a segment belonging to "*On*" (One-dimensional need) is more likely to arrive at "*Mn*" (Must-be need) later in the future. In addition, a company in some cases wishes the shift of the segment belonging to "*Aw*" (Attractive want) to "*An*" (Attractive need). Thus, a product-development team may visually have in mind a big blob in the first quadrant (*I*) which will move unclockwisely to the second quadrant (*A*) in the future, so that they hesitate less to implement the concerned characteristics. In addition, a marketing section may communicate to customers to attempt to push out a big blob on the *want* circle to the *need*.
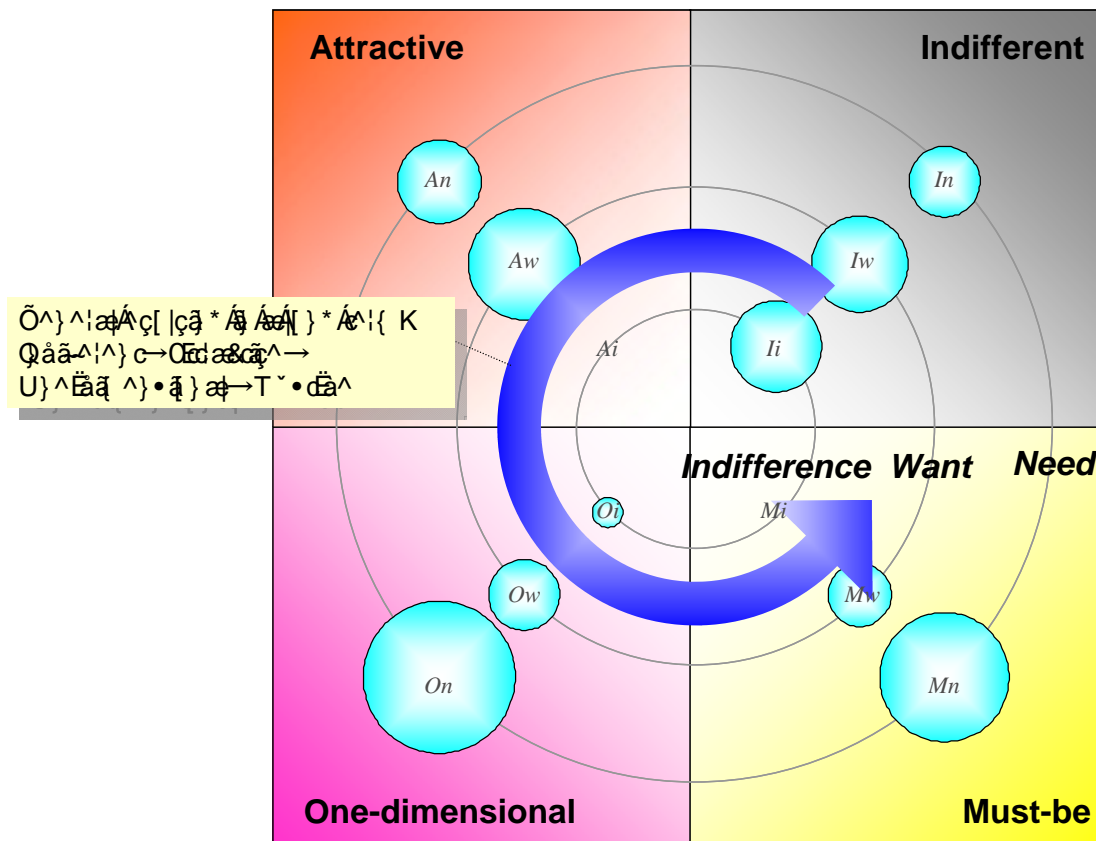
Figure 2. Representation of a group of customers' feeling and response

5.4. Implication for Quality Engineering

The discussion so far in Section 5 showed some potential of using quality-engineering oriented methods/tools to deal with customer perception in the early phase of Ecodesign. Successful utilization of Kano model in Ecodesign has been reported in another literature (Finster, Eagan, *et al.*, 2001). However, there remain very few attempts to do so. On the other hand, in practice of Ecodesign, addressing customer perception is indeed an important issue as shown in some existing literature: For instance, Meyer showed the importance of such issues in apparel industry (Meyer, 2001). In addition, Stevels pointed out relative unsuccessfulness of green marketing strategies in consumer-electronics industry and showed some examples of categorizing consumers from the viewpoint of their environmental consciousness (Stevels, 2000). Namely, high demand to address customer perception is found in this field.

It should be noted that some methods/tools from the field of quality engineering have been successfully developed to be applied to later stages of Ecodesign: For example, there are quite a few QFD-based methods incorporating environmental aspects (Cristofari, Deshmukh, *et al.*, 1996; Zhang, Wang, *et al.*, 1999; Masui, Sakao, *et al.*, 2003; Sakao, 2007).

Thus, the current Ecodesign methods (Fiksel, 1996; UNEP, 1997; Karlsson and Luttropp, 2006; Rahimifard and Clegg, 2007) fail to incorporate quality issues in a systematized and holistic manner. In other words, there is still a gap between demand for methods/tools from practice and supply from theories in the early phase of Ecodesign. Big potential of contribution from quality engineering should be found to fill in the gap. Otherwise, for

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instance, mis-specification of ecodesigned offers would remain in our world, although this is pointed out more than a decade ago (Wong, Turner, *et al.*, 1996).

6. Conclusion and future research implication

This paper first proposed to adopt a quality-engineering approach to Ecodesign. Then, a framework of classifying characteristics upon incorporating environmental consciousness in an early stage of design is presented. To do so, two viewpoints were addressed; offer value and corporate value. In addition, Kano model and CRR were adopted for representing how customers feel and respond, respectively. Furthermore, several design strategies depending on the classes were presented. This classification method was shown to work effectively to classify the environmental characteristics according to the results from the Japanese market. If applied together with the design strategies, this method is a powerful tool for the company who carries out environmental-offer planning.

Future works include to investigate possibilities for other methods/tools in quality engineering to be applied to Ecodesign. In parallel, the method will be applied to real offer-planning in industry. The author's research group has begun the application in housing industry in Japan, where environmental consciousness is nowadays among the key issues for their business partially due to the considerable amount of environmental impacts originating of houses.

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What does GRI-Reporting tell us about Corporate Sustainability?

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Abstract

Originality/value
We critically analyze the most common framework for sustainability reporting on an empirical basis. Our qualitative study delivers insights into sustainability reporting in an industry with large impacts on global climate change and living conditions.

Purpose
We discuss what the business contribution to sustainable development is (or should be) and propose criteria for assessing corporate sustainability. These criteria are applied for the analysis of GRI-reports of five major cement manufacturers. This will result in a discussion if GRI-based sustainability reports really contain the information needed for judging corporate sustainability.

Methodology/approach
Starting from a literature review of common definitions and principals we develop main criteria of corporate sustainability and propose a set of evaluation criteria for analyzing sustainability reports. We consider definitions and principals from concepts such as Eco-efficiency, Triple-Bottom-Line, The Natural Step and stakeholder value.
Using these criteria we analyze the GRI-based sustainability reports of five major cement manufacturers in order to find out to what extent the reports really address the sustainability performance of the companies.
We chose the companies because of their dominant position in the building material supply chain. The building industry has multiple impacts on the environment as well as on the social system. The decisions and actions of the cement manufacturers have influence on the entire supply chain, from raw material suppliers to the end customer.

Findings
Our findings lead to the conclusion that the current GRI guidelines are not sufficient to make sustainability reporting for the cement industry relevant and clear. In other words, the guidelines are not sufficient for assuring that a report answers the questions of how sustainable a company is and how quickly it is approaching sustainability. Within the GRI guidelines the needs of the customers are not considered sufficiently. This points at an important area where business excellence ideas can support sustainability reporting. This could be done, for instance, by including the concept of cost of poor quality into sustainability reporting guidelines.

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Category: Research Paper

Introduction

Sustainable development and Corporate Social Responsibility (CSR) have become part of the ordinary business and there is today an expectation from customers and other stakeholders that companies report how they work with sustainability. In spite of a broad acceptance that we need to work for sustainability there is still debate on how to best define and describe sustainable development. There is a will to do something but not always a clear idea of what. Companies are scrutinized by customers, shareholders, academia and journalists and it is therefore important to find an acceptable strategy for reporting. An important part of any of these strategies is transparency with the specific requirement of publishing a sustainability report. One of the approaches for reporting with growing popularity is the Global Reporting Initiative guidelines. Companies are seemingly spending time and money on the work with a resulting report coming out in 40-100 pages. What should a reader expect from such a report? Simple questions that beg for on answer are how sustainable a company is and how it is working with sustainable development that will lead to a level of sustainability. These are simple but hard to answer questions since they require that a definition has been formulated on what sustainable development means for the organisation. Our questions are if sustainability reports based on to the GRI-guidelines contain the elements needed for describing corporate sustainability / sustainable development and if they give the required answers to the readers.

Approach

We have set out to find common recommendations of how to measure sustainable development and sustainability in order to create a list of requirements that we would expect to find in a sustainability report. We have considered and critically reviewed the Triple-Bottom-Line, Eco-efficiency launched by the World Business Council for Sustainable Development (WBCSD), Global Compact and The Natural Step. We have also looked at the main definition for sustainable development. Additionally we have studied synergies between Total Quality Management and sustainable development and particularly focused on stakeholder theory and on the Cost of Poor Quality as part of sustainability (Isaksson, 2005, 2006). We propose criteria with focus on the measurement of sustainable development. We have limited our study to companies within cement manufacturing. The reason for this is that the main global producers are GRI-reporters and furthermore cement plants have import global effects within all the three dimensions of the Triple Bottom Line. Additionally we have some insight in cement manufacturing which enables us to view the reporting critically. We study the most recent sustainability reports of five major cement companies using our proposed list of criteria.

Definitions for sustainable development and sustainability

The Brundtland Report definition is well quoted and forms a good starting point: "Sustainable Development is development that meets the needs of the present generation, without compromising the ability of future generations to meet their own needs" (WCED, 1987). This can be interpreted as an acknowledgment to future generations as stakeholders. Economic development is needed to solve the great problems that still plague humanity but it should not destroy the resources needed for the coming generations. Already in a report from the 1970s Limits to Growth, a point was made that humankind was facing problems. The report

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examined five factors that limit global growth. These were population, agricultural production, national resources, industrial production and pollution (Meadows et al., 1972). What is sustainable is a function of the viewpoint, which could go from anthropocentric to ecocentric, putting either humans or nature in focus. Even from an anthropocentric view there is a value in nature because of its multiple functions for humans (production, regulations, carrier, information functions (de Groot, 1992).

The definition in the Brundtland Report is rather general. It allows a wide range of different interpretations. Global operative processes could be described as: "Providing a good life for everybody" and "Safeguarding a healthy nature" (Isaksson and Garvare, 2003). This could be seen as an interpretation of the Brundtland Report with the identification of two main stakeholders – humanity and nature. A stakeholder can be defined as: "Any identifiable group or individual who can affect the achievement of an organization's objectives or who is affected by the achievement of an organization's objectives" (Freeman & Reed, 1983). In a broad definition the natural environment (animals, plants, natural resources etc.) is also a stakeholder (Starik, 1995). Due to the fact that nature is an indispensable prerequisite for human life and because of the innumerable resource relationships between the nature and economy some authors argue that nature should be considered as the primordial stakeholder of business. (Driscoll & Starik, 2004; Stead & Stead, 2000; Starik, 1995). The purpose of this discussion is to put sustainable development in a perspective that relates it to global system origins. A focus on humanity and nature points out the role of corporations as means and supports for sustainability, not as the focal point. This means that even if corporate success is a condition for generating value this should not be on the expense of the core stakeholders.

Sustainable development is not only an issue for nations but also for companies. The reason is that without big corporation's participation it will be hard for nations to drive sustainable development. Already in the Rio-Documents the important role of a business contribution for sustainable development was emphasized. Since humans as customers, shareholders, citizens, politicians and managers start to have a good understanding of what is important there is considerable normative pressure on companies and Corporate Social Responsibility (CSR) increasingly becomes a necessity for success. Today many corporations understand that enduring success depends on various stakeholder groups and on the resources they deliver. That does not concern only tangible resources but also intangibles such as employee qualification, information, network access or legitimacy. For a corporation's survival legitimacy of its activities and outcomes is critical because it is considered the social "license to operate" on which every business depends. The challenge for companies is to be able to show how they work with sustainability, not only by reducing pollution, but also in other more complex ways. CSR is a company's commitment to behave socially and environmentally responsible while striving for its economic goals. CSR includes the company's relations with all its stakeholders, from market-related stakeholders (customers, shareowners, suppliers), to internal (e.g. employees, board of directors) or societal stakeholders (e.g. government, NGOs). It is assumed that the variety of the stakeholders and their concerns lead to corporate responsibility including economical, environmental and social aspects. (Zink & Steimle, 2008).

The definition of CSR used by the European Commission reflects a concept "whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis." (European Commission, 2001, 8) In this sense, to act socially responsible means not only abiding by the legal regulations, but also going beyond compliance and investing more into human capital, the environment and the relations with stakeholders. Several CSR initiatives emerged during the last years.

One of the most noted initiatives is the United Nations Global Compact. This network gives a possibility to corporations to show that they, like nations, respect fundamental international standards, such as the Universal Declaration of Human Rights, the International Labor Organization's Declaration on Fundamental Principles and Rights at Work and the Rio Declaration on Environment and Development. It is a network bringing together companies with UN agencies, labor and civil society organizations in order to advance responsible corporate behavior as a business contribution to the challenge of sustainable development in a globalizing economy. The network supports companies in realizing CSR, but also serves as a platform to publicize company's progresses in social and environmental issues. (Leipziger, 2003) If a company wants to become a member of the Compact is has to commit itself to ten principles, which refer to human rights, labor standards, environment and anti-corruption. But if the members of the Compact actually comply with these principles is not being verified.

The growing popularity of initiatives such as the Global Compact or the WBCSD cannot hide the fact that there is still no consensus about defined objectives and measures for sustainable development. But this includes opportunities as well as risks. The broad interpretation range enables a consensus for the different state governments with their partly incompatible interests and also promotes the acceptance of the vision of sustainable development in society and business. On the other side, the lack of binding goals and directives allows rhetorical commitments to sustainability without consequences in behaviour.

The Brundtland Report and the Rio-Documents emphasized interdependencies and interrelations between economic, environmental and social developments. Today the equal weight of these three dimensions is broadly accepted and characteristic for most academic sustainability concepts. Referring to systems theory it is assumed, that if mismanaged (e.g. exceeding specific tolerances) the ecological as well as the social and economic system may loose their ability for self-regulation and break down. Consequently, as a result of positive (i.e. de-stabilizing) feedback mechanisms the other systems will also break down. Besides these interdependencies there often are conflicting goals and trade-off problems between the three dimensions. They have to be balanced in a difficult coordination process in order to refer to development as "sustainable".

Lately global heating has been mentioned as one of the main challenges for humanity and nature. The interpretation of what is sustainable is becoming even harder. One way of trying to relate the different threats is to go back to the main stakeholders, humanity and nature. In the relation diagram in Figure 1 we have related different important problems including the five factors from the Limits to Growth report (Meadows et al., 1972).

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Figure 1 Proposed relation diagram that identifies how the main stakeholders humanity and nature are affected by important global factors. The dotted arrows indicate important reinforcing loops.

The intention is to present approximate relations based on commonly known facts (see e.g. Brown et al., 2007). There are probably important things missing and some of the relations could be disputed but still the relations show how humanity and nature could be affected by different activities. For any corporation it is important to retain the big picture view when describing their role in sustainable development.

The WBCSD coined the expression Eco-efficiency as: "Eco-efficiency is achieved by the delivery of competitively-priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life-cycle to a level at least in line with the earths estimated carrying capacity. In short, it is concerned with creating more value with less impact" (WBCSD, 2000). This is a way of showing responsibility by linking value to harm. The Triple Bottom Line that describes performance in the economic, environmental and social dimensions has become an accepted way of reporting. This is referred to by the WBCSD and the SAM sustainability index (SAM, 2008).. The problem here is relating the different dimensions. SAM has created a score for each dimension that adds up to one index. The Eco-efficiency proposes the idea of a ratio. In order to live up to the Brundtland Report definition we need to decouple economic growth from pollution (Geiss et al., 2003). Here value is seen as the value created for

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companies and ultimately shareholders. Taking the carbon dioxide emissions as an example, the CO_2-productivity used as a term for companies represents this value per harm idea. On a national level, performance can be expressed in GNP/t CO_2 eq. For Sweden this figure is about 4000 Euro/t CO_2. The world average is roughly 1000 EURO/t CO_2 based on estimated 2008 year figures (Word Gross Product at 40 trillion Euros and world total CO_2-eq. emissions at 40 billion tonnes). While weak eco-efficiency only refers to a better value per harm ratio, strong eco-efficiency additionally requires an absolute reduction of environmental harm (von Hauff, Kleine, Jörg, 2005). This means that value per harm could be useful way of comparing processes but not enough to guarantee sustainability.

The Natural Step (TNS) defines four principles for sustainability which are expressed as follows:
"In order for society to be sustainable, nature's functions and diversity are not systematically subject to:

> I. increasing concentrations of substances extracted from the Earth's crust;

> II. increasing concentrations of substances produced by society;

> III. physical impoverishment by over-harvesting or other forms of ecosystem manipulation; and

> IV. resources are used fairly and efficiently in order to meet basic human needs worldwide". (Robert, 2000)

All these conditions are required for sustainability. If we use this definition, which can be scientifically supported, the conclusion is that a large part of human activity is not sustainable. In order to have a practical relevance the TNS theory uses backcasting, which creates a vision of a sustainable system (Robért, 2000). This vision is then compared with the current situation and the information is used to create a road map towards sustainability. For this roadmap it should be possible to use value per harm indicators.

Sustainability exemplified with global heating

We could apply backcasting to find out what targets we should set for the indicator value produced per t CO_2. There is currently a broad understanding based on the work of the IPCC that we should avoid a global temperature increase beyond 2 °C, where the risk increases of passing a tipping point that can lead to uncontrolled heating of the Earth. In order to do this we might have to reduce global CO_2-equivalent emissions with 70% until 2050 from 2008 year levels. Even if this particular target is debatable we use it as an example to show how global system requirements could be factored into sustainability reporting. To reduce emissions we could proceed with two extremes. The first is focusing on reductions of CO_2 without considering the effects on economic activity. Since we also need to see that development "meets the needs of the present generation" this would mean some kind of sharing of resources. If we assume the current ratio of 1000 Euro/t CO_2 at an average of 6 t CO_2 per person and year and the target level of emissions down to less than 2 t CO_2 per person and year we can conclude that we should in this case survive at an average of less than 300 Euro per year. This might seem silly but could be the ultimate result of focus on only reducing emissions exemplified with the often heard demand to stop flying to tourist destinations and to stop importing agricultural goods from distant Third World countries. The dominating proposal is to decouple the value creating from CO_2-emissions and to have sustainable growth. McKinsey comments that CO_2 productivity should increase about 5-7%

per year instead of the current 1%. A 7% increase per year until 2050 results in an increase of about 17 times. This means that we need to produce about 17 000 Euro/t CO_2. Isaksson et al. (2008) discuss the difficulties with operationalisation of sustainable development and sustainability. (Newton, 2003) labels True Sustainability (TS) of organizations as: *"when a social structure can be maintained profitably and indefinitely, without degrading the systems on which it depends"*. True Sustainable Development is defined as the rate required from the current level to the target level within the time span available (Isaksson et al., 2008). For the indicator of Euro/t CO_2 we need an average rate of improvement of 7%. For some branches like cement manufacturing with a currently low CO_2-productivity of about 100 Euro/tonne CO_2 the increase would have to be 20% per year over 40 years. For any company or organisation it should be of importance to assess the CO2-productivity and future requirements on it.

We argue that this view of carbon productivity and reference to global limits includes both the TNS backcasting and the Eco-efficiency. Hence, we conclude that one important test of sustainability and sustainable development is to compare with the expected position (True Sustainability) and the rate of approaching it (True Sustainable Development. For the Eco-efficiency variable of Euro/t CO_2.

Measuring and assessing performance

We could apply the Eco-efficiency "value per harm" in a broader sense and state that focus should be on maximising the value produced for all stakeholders compared to the harm done to all stakeholders over the life time of the system. An additional condition is that there are maximal levels of harm for all of the stakeholders. For example, the concept of „Critical Loads", „Critical Levels" and „Critical Structural Changes" represents maximum levels of harm for nature. (SRU, 1994)

Customer focus adds an aspect to the economic dimension of sustainability by focusing on customer value and on the losses of customer value in the form of Costs for Poor Quality (Campanella, 1999). Cost of Poor Quality (CPQ) has been defined by Joseph Juran: The costs of poor quality are zero when processes and products are perfect. A company with a high CPQ could still be profitable by passing the costs to the customer by overcharging, (Isaksson, 2005). This indicates that the sales value produced is a necessary but not a sufficient indicator for economic sustainability. In a perfect market the company producing the best perceived customer value gets the business. We therefore argue that customer value can serve as an indicator for the economic dimension of the Triple Bottom Line with the benchmark being a perfect product from a perfect process. Using the principle from Eco-efficiency we can relate this value to harm. To simplify and exemplify we can choose the main environmental harm for a company. For many industries this could be the CO_2-emissions. In order to address the social dimension we claim that in the case of basic products sold in poor countries price is an important indicator for social harm. It can be shown that poor often pay more than rich for basic goods, (Prahalad, 2006). Prahalad argues that there is money to be made at the bottom of the pyramid, but that is also could be seen as doing social good. The important issue for poor and rich, however, is the value for price ratio. The TBL for cement industry could therefore, based on (Isaksson, 2007) be simplified to:

- Economic performance: Customer value
- Environmental performance: Customer value/environmental harm
- Social performance: Customer value/price

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Comparing customer value to price is common in different types of consumer magazines that rate different products. Another argument for using value/price as a social indicator and as part of the TBL is that paying less for commodities liberates money for other purchases that can improve well-being. When more customer value is produced for the same product unit this leads at the same level of customer consumption to reduced production and thereby reduced emissions.

We believe that when possible the KPI customer value per environmental harm and price as social harm should be included when sustainability and sustainable development are assessed. Establishing benchmarks could be challenging in some cases, but should not be impossible.

Assessing sustainability reporting

Various recommendations and guidelines for sustainability reporting have been published during the last years. Most prominent and most widely used are the Global Reporting Initiative (GRI) Guidelines. GRI was founded in 1997 by the Coalition for Environmentally Responsible Economies (CERES) and the United Nations Environmental Programme (UNEP). The GRI Guidelines were initially published in 2000. Their purpose is to support companies in creating sustainability reports that integrate social, environmental and economic impacts of business. The GRI intends to establish their guidelines as an internationally accepted framework that promotes comparable sustainability reporting. The current version of the guidelines (GRI-G3) was published in 2006. The new framework contains principles and guidance for defining content and quality of the sustainability report as well as for setting the report boundaries, i.e. the decision, which entities of the company are included in the report. The guidelines require standard contents for sustainability reporting regarding the organization's profile, its governance-structures and processes, and the management of sustainability issues including goals and environmental, social and economic performance indicators. In the context of a comprehensive CSR approach it can be seen as strength that GRI guidelines are compatible with the principles of the United Nation Global Compact.

To give an answer to the research question "What does GRI-Reporting tell about Corporate Sustainability?" we decided to assess the GRI-structured Sustainability Reports of five major building material manufacturers. Our aim was to find out to what extent the reports really address the sustainability performance of the companies. We chose the companies because of their dominant position in the building material supply chain. The decisions and actions of the building material manufacturers influence the entire building supply chain, from raw material suppliers to the end customer of the completed building. The building industry has multiple impacts on all the Triple Bottom Line dimensions globally.

We chose an approach in some aspects similar to the Structuring Content Analysis as described by (Mayring, 1990). This technique aims to extract specific aspects from the entire text material and to estimate the contents under certain criteria. For extracting relevant contents from the sustainability reports we created four criteria based on our theoretical assumptions. Then we identified sections and paragraphs in the reports, which include contents related to these criteria and made a compilation of relevant material for each company.
The simple question of an interested reader looking at a sustainability report is how sustainable is the company and how are they improving. In order to assess this, what is presented should be relevant. See figure 2 for a proposal.

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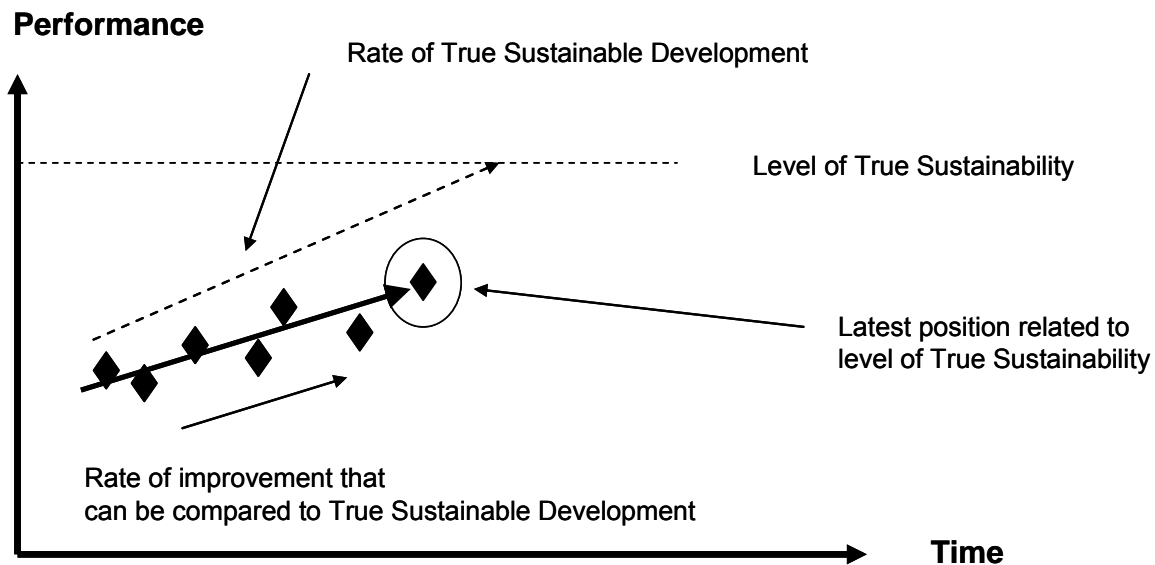
Performance

Figure 2 Performance in function of time that describes level of sustainability and progress towards sustainability for relevant indicators.

This would mean that the company has identified its main sustainability aspects and created relevant indicators for monitoring the position and development. We will therefore focus our assessment on results presented in relation to what would be expected when looking at the main stakeholders and main sustainability aspects. Based on our previous discussions we focus on how sustainability reports address effects on global warming and on poverty because we consider those as the main sustainability issues. This puts focus on the stakeholders customer and nature.

We base our assessment on four main criteria:

1. Relevance of chosen KPIs: Which indicators are reported that refer to customer value, environmental harm and social harm?
2. Clarity of level - How well are the main indicators describing the relative level of sustainability compared to other companies in the same industry?
3. Clarity of improvement - How well are main indicators describing progress? Are trends reported and are the trends benchmarked?
4. System view - Have benchmarks been defined in such a way that it is possible to relate indicators to objective sustainability requirements (True Sustainability and True Sustainable Development)

Assessing the cement industry

Before carrying out the assessment of the sustainability reports we convert our general assessment to a specific one for the cement industry.

The global cement industry is currently responsible for 5% of the man made carbon emissions, (WBCSD, 2002). The industry is growing with a rate of some 4% per year, mainly in the developing countries. Cement manufacturing forms an important part in the building material supply chain. Buildings are currently consuming some 40% of the world's energy requirements and the effect on CO_2-emissions from the building sector is considerable, (WBCSD, 2007). For housing we could find a benchmark level of space needed and benchmark energy consumption for the lifespan of a building in for example person m^2 living space per year/t CO_2. It is generally acknowledged that the main environmental challenge in

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the cement industry consists of reducing CO_2-emissions. For large urban centres in Third World countries concrete is often the main building material which cannot easily be substituted. Hence, the environmental challenge is to maximise building value for minimised CO_2-emissions. Our value per environmental harm indicator becomes building value per CO_2-emissions. Since building needs are high in poor countries we argue that cement price is an important social indicator. The best contribution from the industry for alleviating poverty is by providing maximal building value for minimal price. This means that reporting in order to be relevant should contain information of the value produced for customers and the harm done in form of CO2 -emissions and prices paid by customers. The main driver of CO2-emissions is the fuel consumed for clinker burning and therefore the specific energy consumption for this is of interest.

Findings

All the companies in our study follow the Cement Sustainability Initiative of the WBCSD recommendations that also recommend the use of the GRI reporting guidelines. To indicate that a report is GRI-based the companies are expected to self-declare the so-called Application Level (C, B or A) that describes to which extent the report covers the GRI Reporting Framework. The A level requires the most comprehensive coverage of the GRI criteria. Additionally, the reporting companies can obtain a third party opinion on the accuracy of the self-declared Application Level or let the Global Reporting Initiative check the self-declaration.

If external assurance was applied for the report, the Application Levels of C+, B+ or A+ can be declared to indicate that the report was evaluated by a qualified and independent organisation. In this case a statement of the assurance provider has to be added to the report.

One company in our study does not declare an Application Level, but states that GRI guidelines were used as a basis for the report (Heidelberg Cement 2007). The other sustainability reports are self-declared Application Level B (Lafarge 2007), GRI checked Level B (CEMEX 2006), third party checked Level A+ (TITAN 2007), and GRI checked Application Level A+ (Holcim 2007). We therefore conclude that the reports can be used for empirically assessing GRI-based sustainability reporting.

Relevance of chosen KPIs

While climate change is one of the main issues in all the reports, poverty issues are weighted differently. In our analysis the question is how value for customer is presented and how well the value produced is compared to harm done. Our findings from the analysis of the sustainability reports can be summarized as follows:

- Value produced is given in total tonnes of cement sold and/or in the sales value and its distribution. There is no quantitative assessment of customer value but in some reports customer focus and its importance as well as customer satisfaction measurements are mentioned. Several qualitative statements related to value per harm can be found such as "We are as much concerned about minimizing these impacts as we are about maximizing the benefits."
- Carbon emissions are reported as total and specifically as kg CO_2/tonne cement by all companies and in some reports indirectly as percentage of clinker per tonne of cement. These are the indicators closest to the idea of value per harm.
- Specific energy consumption per tonne of clinker is only reported by some companies.
- Social indicators focus on human resources (e.g. training, occupational health and safety), community and doing charity. Poverty is sometimes mentioned as an important issue and there are single initiatives (e.g. cement donations for social projects or special credit

systems for low income customers in single regions), but no quantitative indicators are reported regarding market prices.

Clarity of position

We found no comparisons of environmental main indicators (absolute and specific CO_2 emissions and specific energy consumption for clinker) with results of other companies or with industry average. None of the reports contains comparisons of social indicators other than accident or fatality rates.

Clarity of change

The majority of the companies present trends for three or more years for the environmental main indicators.. Comparisons of progress with other companies or with industry average cannot be found in the analyzed reports.

System view

All the cement manufacturers in our study set targets to reduce CO_2-emissions per tonne with a certain percentage in a defined time period (e.g. 20% reduction from 1990 to 2010). However, these targets are in no case related to external requirements of True Sustainable Development. Technical limits for specific energy consumption and for clinker substitution are not taken up. There is no explicit discussion on carbon productivity and the challenge the industry has in improving its carbon productivity.

Other findings

Looking at the sustainability reports from a TQM or excellence perspective some areas for improvement become obvious. First of all, in the reports there is no clear differentiation of enablers and results. This is could originate from the fact that the GRI guidelines lack both customer focus and process orientation. Resource indicators and result indicators are not differentiated, but all considered to be bottom-line indicators. Lafarge discusses the importance of looking at the entire life cycle of buildings and points out that construction material only corresponds to 12% of the energy use when studied over a 50 year lifespan for a building. This could be one way of considerably improving the carbon productivity by focusing on the end product of living space instead of on cement only. Cemex has an initiative called "Patrimonio Hoy" where low income families are receiving help with financing house extensions and house building. Some companies report on their environmental management systems and one even indicates that a Sustainability Management System that will be mandatory for all business units is being implemented at the moment.

Conclusions and discussion

The conclusions from our findings are that performance indicators in the reports are only partly relevant. Information on the main environmental harm of CO_2-emissions is well presented and it is partly related to performance when given as a ratio of emissions per tonne of cement. However the value of the tonne of cement is not clearly expressed since cement comes in different strength classes. Based on the European Standard there are three classes of cement which have minimum performance for the compressive strength at 28 days rated as 32,5, 42,5 and 52,5 Mega Pascal (MPa) (EN 197-1, 2000). Internationally there are standards with even lower strengths, which means that cement performance could range from 30 to 60 MPa as the 28 day value. Since building value can be related to cement strength the value for a tonne of cement could vary with a factor of two. Theoretically it would thus be possible for a cement company to reduce the percentage of clinker and the carbon emissions per tonne by lowering the quality.

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All companies elaborate on the use of alternative fuels and plans for increasing the percentage. There is no mention that an increased used of waste fuels normally leads to increased specific energy consumption for clinker burning. Those companies reporting the specific energy consumption show either a stable level or an increase in the specific energy consumption. The reported levels are about 20% above best possible performance. It could be debated if the substitution rate with alternative fuels really is the environmental indicator that the industry claims it to be. This means that an increase in specific energy consumption due to use of alternative fuels is not acceptable.

The majority of world's population is poor and developing countries are the main market for most global cement companies. Considering this, the conclusion must be that the social reporting has a very low relevance due to lack of customer focus. For the low income customer the most important thing is performance per price. None of the companies reports this.

For the environmental indicators reported most companies report both level and progress, but compare neither level nor progress to industry benchmarks. For the reader it becomes very difficult to know how a particular company compares with another one.

Global requirements on carbon emissions are not translated to company targets. For instance, Lafarge looks at the future and describes a vision of reduced energy use in buildings with 75%. This is however not translated to any improvement requirements for cement production.

Since all companies follow the GRI-G3 guidelines this leads to the conclusion that these are not sufficient to make sustainability reporting for the cement industry relevant and clear. In other words, the guidelines are not sufficient for creating a report that answers the questions of how sustainable a company is and how quickly they are approaching sustainability (if not sustainable).

This analysis of the sustainability reports shows that the needs of the customers are not considered sufficiently within GRI-G3. This highlights an important area where business excellence theory can support sustainability reporting. This could be done, for instance, by including the concept of cost of poor quality into sustainability reporting guidelines.

The main limitation of our research stems from the fact that only one industry was considered. For the cement industry we can show that sustainability reports do not contain all relevant information for judging corporate sustainability even though they are rated A according to the Application Levels of GRI. We suppose that this is also true for other industries, but further empirical research remains to be done.
Furthermore, our results and conclusions regarding the GRI-G3 are strongly determined by the evaluation criteria we used and the underlying definition of corporate sustainability – there are, of course, no "right" or "wrong" definitions of this normative concept.

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Sustainability Performance Measurement for sustainable organizations: beyond compliance and reporting

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1. Introduction

The end of 20th century observed unprecedented prominent changes in corporate strategy and management towards sustainable thinking - the emergence of sustainability as corporate strategy, and making sustainability an integral part of a company's business strategy in order to obtain the bottom-line benefits (Enquist et.al., 2007a; Epstein 2008). But, this is requires a dramatic changes in the organizations' performance against the economic, social and environmental (triple) bottom lines (Elkington, 1998), and paying more and more attention to their values and responsibility (Enquist et.al. 2006). Sustainability is also necessitates the transformation of mindset and commitment of the leadership and organizational performance to include key stakeholders (Laszlo, 2003; Waddock and Bodwell, 2007). Managing sustainability holistically is challenging and requires a sound management framework that integrates environmental and social performance with economic business performance (Johnson 2007; Schaltegger and Wagner, 2006; Epstein and Roy, 2003). However, Schaltegger and Wagner, (2006) raises a vital question on managing sustainability as its activities may result in establishing a parallel organisation within the company dealing with non-economic issues and measuring non-economic aspects of performance. Epstein, (2008) also indicates that the management is increasingly asking how companies can improve sustainability performance, and, more specifically, how they can identify, manage and measure the drivers of improved sustainability and the systems and structures that can be created to improve performance measurements. Thus sustainability performance measurement (SPM) has to include several factors based on the economic, ecological, and societal issues (Epstein, 2008; Johnson, 2007; Waddock and Bodwell, 2007; Schaltegger and Wagner, 2006; DeSimone and Popoff, 2003).

The paper will introduce SPM based on the organization's values and its ability to communicate and implement its strategies through proactive Corporate Social Responsibility (CSR) thinking; in order to integrate both economic and non-economic issues and measuring non-economic perspectives of the organization. This will assess, in this paper, Enquist et.al.'s (2006) view of a value driven company by applying Waddock and Bodwell (2007) approach for total responsibility management (TRM) and by in integrating Post et al.'s, (2002) descriptive, instrumental and normative contributions of stakeholder view. Subsequently, it will illustrate different sustainability measurement indicators and the leadership commitment to act beyond *certification* towards being *sustainable* company with the following research

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questions: "Is the company complying with the rules and regulations, efficient enough in integrating management systems and/or measurements and reporting for being sustainable?"

The article will be of an explorative nature. The paper presents concepts of—(i) SPM (ii) organizational change with a sustainability meaning; and (iii) CSR. The paper then illustrates these concepts, based on a theoretical framework, in a case study of Flügger AB (Sweden), a company that has undergone a comprehensive transformation process over a period of more than fifteen years. The company was acting beyond certification to break out of the crises and became efficient in integrating different systems. The paper subsequently draws together the conceptual analysis and the case study in a discussion of how sustainability performance measurement can assess organizations sustainability. Also, develops a framework to asses' organizations' obligation towards sustainability holistically, both internally and externally and the generalizations of the case. The study concludes with some managerial implications and suggestions for further research. Because of the limit space for a QMOD paper the focus is on the conceptual and theoretical analysis part and the empirical part and discussion/conclusion has to be further developed.

The paper makes an original contribution to the study of sustainability performance measurement by explicitly introducing a framework for sustainable organization.

2. Conceptual and theoretical analysis

Sustainability performance measurement (SPM)
Yet few, if any, companies can respond definitively to the questions, "Which of your products, processes, services, and facilities are really sustainable? Is it a sustainable organization?" Answering these questions is requiring the ability to measure sustainability of economic and non-economic factors in a quantitative or at least qualitative approach. Sustainability has been defined as economic development that meets today's generation needs without compromising the opportunity and ability for future generations (Brundtland, 1985). Sustainability is complex and multi-faceted, covering a broad spectrum of topics from habitat conservation, to energy consumption, to stakeholder satisfaction and financial results. The original or literal meaning of the term is equivalent to permanence and implies notion of durability, stability and eternalness (Cheney et.al, 2004). The simple word sustainability, however, implies no presumption of economic development (Ehrenfeld, 2005). For many people, sustainability translates into being "environmentally friendly", but it is broader than that (Enquist et.al, 2007a, Petros and Enquist, 2007). It represents much more than reducing energy and waste, protecting ecology and recycling (Epstein, 2008; Petros and Enquist, 2007; DeSimone and Popoff, 2003). Therefore, measuring sustainability holistically differs from measuring other dimensions of business performance in several important respects (Epstein, 2008; Schaltegger and Wagner, 2006). *Sustainability performance can be defined as the performance of a company in all dimensions and for all drivers of corporate sustainability* (Schaltegger and Wagner, 2006, p.2). It extends beyond the boundaries of a single company and typically addresses the performance of both upstream suppliers and downstream customers in the value chain (Fiksel et.al, 1999).

The widely applied sustainability measures only have an environmental parameter, such as quantities of substances emitted and resources used, which are not sustainability measures; because they only have a cover to one side of the equation (DeSimone and Popoff, 2003). Fiksel et.al, (1999) argues that SPM must be approached as a systematic business process in

order to be integrated effectively into company strategic planning and day-to-day operations. It deals with the social, environmental and economic aspects (Elkington, 1998) of the companies in general, and of corporate sustainability performance in particular (Epstein, 2008; Schaltegger and Wagner, 2006; Epstein and Roy, 2003; Schaltegger et al., 2003; Johnson 2008).

Sustainability performance reflects one target end of the move of companies in the corporate responsibilities continuum (Bhimani and Soonawalla, 2005; Schaltegger and Wagner, 2006; Johnson, 2007) from corporate conformance, certifying, compliance and reporting with given standards to corporate performance in relation to stakeholder expectations (Epstein, 2008). Although performance measurement has a long history (Neely, 1998) early empirical research into environmental and social (performance) management and reporting was partly founded in the 1970s business ethics debate (Schaltegger and Wagner, 2006). Business strategists, in the last three decades, have developed wide internal management systems and measurements. A range of methods and initiatives were developed in the last two decades to measure different performance of organizations; including principles of sustainability measurement, sustainability accounting, sustainability reporting initiative and other economic measurements. Nevertheless according to Schaltegger and Wagner, (2006) the research during the 1980s, which centred around two features, had also made main contribution to the study. The first dealt with the societal (i.e., environmental and social) performance of corporations. The second focused on a theoretical discussion of how to define and measure environmental and social performance, CSR or corporate citizenship. In general, measuring organizational performance is difficult, especially when what has to be measured keeps changing (Hubbard, 2006).

Corporate social responsibility and performance
The role of CSR in covering corporate responsibilities that address a company's voluntary or optional relationships with its environmental and societal stakeholders has been under debate (Enquist et. al, 2007a). The early 60's, awareness for environmental problems started to motivate the emergence of a new 'ecological' vision of society. Despite Friedman's (1970) argument against business responsibilities to other factors other than the responsibility to increase its profits. This new vision was becoming part of globalization and the internationalization of markets, leading to the emergence of sustainability; distinct guidelines and standards to ease everyday life and comprehend the effects on society, the economy, and the environment (Elkington, 2001). In spite of, Carrol's (1991; 1979) view of CSR on businesses' intent to improve an important aspect of the society or relationships with communities. Grant (1991) dismissed Friedman's (1970) restricted point of view as fallacious, which agreed by most researchers.

CSR is mainly defined as concepts and strategies by which companies voluntarily integrate social and environmental concerns with their business operations and stakeholder interaction (Enquist et.al., 2006). CSR based on Triple Bottom Line, i.e., economic, social and environmental, as a sustainability concept could presupposes a balance between those three issues and creates a more holistic image of the complexity of sustainable development (Elkington, 1998; Enquist et.al., 2006). Further more, environmental efficiency is becoming a dynamic strategy, which presupposes that social expectations of corporate environmental performance are constantly rising (DeSimone and Popoff, 2000). The adoption of environmental initiatives by a company can also be as a result of its concern for its social obligations and values (Bansal and Roth 2000; DeSimone and Popoff, 2000). In other words,

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CSR is the concept that an organization is accountable for its impact on all relevant stakeholders.

Enquist et.al. (2006), conceived CSR as an institutional pressure levelled against organizations. In analysing the effects of CSR, Enquist et.al. (2006) cite Oliver's (1991) typology regarding strategic responses to institutional pressures as an important contribution to neoclassical economies. But neoclassical economies theory is giving no guidance on the ethical dimension of CSR. To fill this gap in the institutional analysis, Enquist et.al (2006) draw manifestations of CSR based on Oliver (1991) typology. Even though, they argued that the explanation power in later case is weaker, especially when it comes to a specific institutional pressure. Therefore, Enquist et al. (2006) empower Oliver's (1991) typology with Roberts (2003) manifestations of CSR, in order to understand the management practices of sustainable organizations.

Schaltegger and Wagner, (2006) argue that CSR definitions, based on Carroll, (1999; 1979); fail to consider the general economic relevance of corporate societal engagement. As well its activities may result in establishing a parallel organisation in the company (e.g., environmental department and delegates, or employee relations) dealing with non-economic issues and measuring non-economic aspects of performance. This argument is one of the departure points for this paper towards assessing CSR and sustainability performance on organizations. Besides, Vogel (2005) has utilised a broader concept of CSR when describing it as a "market for virtue". He investigates whether there is a business case for CSR. His answer seems to be yes, but with two constraints; although, as Vogel also says, no one has ever proven the opposite. Xueming & Bhattacharya (2006) have tried to answer the question between CSR and profit based on secondary data where the relationship between CSR, Customer Satisfaction and Market Value is investigated. Recently, Edvardsson and Enquist, (2008) based on their past studies proved that CSR can be a proactive approach and business model for values based companies.

Organizational change for Sustainability

The concept of sustainability with regard to organizational change can be defined in various ways; as sustainability cannot be defined for a single corporation (organization) (Elkington, 1998). Buchanan et.al. (2003), consider sustainability on a continuum of work methods, goal attainment and process of development. Maintaining work methods suggests a static view; as an evolving social, economic, technological and political context can render work methods and targets obsolete. A focus on ongoing development suggests a more dynamic or evolutionary perspective. They conclude that there is no 'one correct' generic definition of this term, which will acquire different meanings in different organizational contexts, at different times.

This discussion considers sustainability a type of change involved in organizations upon top managements' decision and commitment. Leadership is one of the single most important requirements of sustainability and organizational change; as top management's commitment is a basis for change (Enquist et.al, 2007a; Waddock and Bodwell, 2007). Companies as an institution are requiring a shift in mind-set and practical initiatives to integrate stakeholder management to face the prospect of an evolutionary leap to sustainable value (Laszlo, 2003). Stakeholder management practices have favourably affected the long-term performance and status of companies through the implementation process, governance and its impacts (Post et al., 2002). Edvardsson and Enquist (2006) and Enquist et.al, (2007b) put a good example of

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companies that their leadership commitment act as value-creators for their main stakeholders and in return to their stockholders. Creating Efficiency through its ability to integrate and adopt different systems and measurements - an approach for TRM as described by Waddock and Bodwell, (2007), is also a main departure of management towards change. TRM consist systems and procedures to ensure responsible business practices and management.

Determining organizational changes have been persistent in a given specific nature of the pattern of change under consideration in each organization. In this change process an integrated perspective on sustainability is necessary to capture the complex set of corporate responses to the wide array of influences (Benn and Dunphy, 2004). This supports an evolutionary change concept of sustainability based on continuous developments, i.e. way of organizational change with the introduction of different systems, standards, such as EMS-ISO 14001 with reporting, such as GRI. Continuous change may only be effective where the timing and pace are carefully phased (Abrahamson, 2000; Myerson, 2001) with effective management systems (Enquist et.al., 2006). However, many organizations sought to achieve sustainability during the 1990s, generating 'initiative fatigue' (Buchanan et.al., 1999; Morgan, 2001; Buchanan et.al., 2003). Sustainability can thus be damaging, and it may be advantageous for some initiatives to decay. It is unrealistic to regard the concept of sustainability as desirable in all contexts and circumstances (Buchanan et.al, 2003).

The edge of this paper is to asses the performance of organizations sustainability based on long-term strategic change. Many corporations now market themselves as a "compliant" according to standards set by different bodies, both governmental and non-governmental or society. However, transformation from being only "compliant" is also coming to recognize the benefits for the firm, which working in the new system. This could only lead organizations towards environmental social and economic sustainability and/or TBL and beyond (Enquist et.al, 2007b). According to Benn and Dunphy (2004), the principles of industrial ecology, of community, interconnectedness and cooperation, can be seen as a model for corporation wishing to move towards sustainability (Ehrenfeld 2000).

Summary

Based on the above theoretical and conceptual discussion an SPM framework is developed below in table1. This frame work will be adopted in the case to analyse the organization's surface based on TBL and the internal performance based on TRM.

Environment	Performance Measurements	Indicators
Surface/External	**Triple Bottom Line - Elkington, 1998**	Environmental
		Social
		Economic
Internal	**TRM - Leadership**	
	Waddock and Bodwell, 2007	Integration (different standards)
	Post et al., 2002	Descriptive/Potential-values
		Normative/Core-values
		Instrumental/Value- creation

Table1: SPM indicators

3. Empirical study

Research design

I have been following developments at Flügger AB (Sweden) of several years. Data for the case study was collected by analysing documents and reports (internal and external), collecting media articles, Internet documents and information, and relevant publications and personal observations at the plant, which were covered in detail as a part of my Master's thesis. Furthermore, I interviewed three Flügger AB employees in different managerial positions, as well as the consultant from Miljöcentrum[1]. This has provided me with an extensive basis for developing this case. I also rely on experience and the literature in order to present the evidence in various ways using different interpretations and measurements, as the interest in this case relates to organizational change rather than specific problems.

The construct of this case study is "designed with purpose" (Harrison and Freeman, 1999) to analyze and conduct an in-depth study of the role of CSR and its affects on sustainability and service development at the Flügger AB in Sweden. The case study method was chosen in order to assess and reveal the strength and extremity (Yin, 1994) of creating sustainability and value. The study focuses on narrating (Pentland, 1999) the period following Flügger AB (Sweden) being assaulted by the media in the early 1990s and draws some theoretical findings (Eisenhardt and Graebner, 2007).

Flügger AB. Case Study

The Flügger Group is one of Scandinavia's leading manufacturers and sellers of paint and home décor products. The Swedish plant in Bollebygd, which is the major object of this case study, has a paint production capacity of more than 13.8 million litres/annum (in 2004), with an annual turnover of MSEK 457 (2003/04), approximately 300 employees, and accounting for 34% of the Flügger Group's total production. The group has more than 400 "Flügger décor" shops in Sweden and engaged in "Home décor solutions", by offering pre and post sales service.

The early 1990's assault by the media for irresponsible environmental actions, especially after a major incident involving an organic solvents leak into the River Sörån, was led Flügger for strategic response; to become greener, create value for its customers and adopt new business model. The management was focused, at the time, on maximizing product sales and increasing profits. And they did believe that the company was taking environmental issues seriously. But, an initial investigation at the time showed that the plant was in a terrible state as regards environmental safety. As a matter of fact, in 1991, the company had been at the crossroads of either being a pioneer in environmental sustainability and create value from social responsibility or going out of business.

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[1] Miljöcentrum was founded in 1971 by Björn Gillberg (Hon. Ph.D.), President, to inform and educate the public about the effects and means of reducing or eliminating pollution. It is a non-profit organization that is funded by voluntary contributions from Swedish citizens (without receiving any support from government or industry). The centre has also been involved in consulting for public and/or private organizations by offering the best scientific solutions to their environmental problems. Moreover, Miljöcentrum's environmental strategy is to lodge claims for damages against polluting companies – using the legal system as a weapon.

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The management has forced to make a strategic decision, an initial decision, to alter Flügger's image in 1992 by establishing an internal environment and quality policy as a necessity for survival. The first step consisted of implementing a widely-accepted quality management system ISO 9001. The company was awarded its ISO 9001 certificate for quality in 1994. Consequently, it was decided that the management system for quality should be extended to include external dimensions of the environment. Thus, Flügger started to look deeply into the environmental management systems that were available at the time. Hence, Flüggers' management made an enterprising decision and asked the highly-acknowledged and technologically hardcore environmental centre, Miljöcentrum, to assist them. Following successful implementation, Flügger received its ISO 14001 certificate and EMAS registration on 30 May 1996. This was a basis for its achievements in transforming the organization and creates a ground for new products development. This individual decision also turned the industry's view and the nature of competition in the marketplace.

In analyzing the achievements and progresses of Flügger AB in the last ten years, I adopted the triple bottom lines, based on the available sustainability standards and systems.

Sustainability Performance Measurement

Different indicators based on their internal and external effects through ISO14001 and other long-term effects can measure environmental performance of Flügger AB. To keep up the employees' level of knowledge is also an extremely important aspect and a substantial part of continues learning and improvement process in the company. Such a constant learning process requires encouragement and supportive measures.

Benchmarking: The 1995 Miljöcentrum's report was a well-founded benchmark to start on. The success of Flügger's attempts to achieve environmental sustainability is reflected in Miljöcentrum's reports on the company. Having recorded 628 adverse environmental observations between 1995 and 1999, the agency's reports contained no negative observations whatsoever between 2000 and 2004.

Environmental Measures:
    Process water and hydrocarbons - towards a closed system: The Company's *water-treatment* system resulted in a waterfall on the River Sörån becoming pristine enough to be a suitable spawning environment for salmon and bought by the local administrative authority in 2004. By May 1999 the waste-water system had been completely closed as a result of the installation of a distillation plant, and process water is no longer discharged into the river.

A 'bio-bed' has also been installed. This has reduced biological residues in the plant's *air-ventilation system* by 85% since 1994, despite an increase in production.
    Waste: Wastes were reduced by 61.5% from 1992 to 1997. The goal had been to reduce total volumes of waste from 338 litres/1000 litres of product in 1992 to a maximum of 150 litres/1000 litres of product in 2005; however, this target was achieved between 1997 and 2001. Further waste reduction has been achieved by requiring suppliers to introduce EMS and use environmentally friendly packaging. All solid waste is now recycled or used in energy production. Flügger has also made significant progress in reducing indirect waste in the form of plastic packaging, steel cans, and cardboard. This decreased by 164.5 tonnes from 1994 to 2004, despite an increase in production and sales.
    Organic solvents in paint: The *substitution* of organic solvent-based products with water-based products drastically reduced emissions of organic solvents during application by

approximately 400 tonnes by 2004. Emissions during production were as well reduced from 5.13 grammes/litre in 1991 to 0.254 grammes/ litre in 2004.

New product development: The Company developed, as the first paint producer in Sweden, a high-quality wood-oil free from organic solvents called Träolja.

Substituted raw materials: 16 toxic substances (including fungicides, softeners, wood protectors, dispersers, biocides, and emulsifiers) had been replaced by environmentally friendly alternatives in the period from 1994 to 2004.

Energy consumption: With respect to *energy consumption,* the results were not as good. Flügger's consumption of oil per kg of produced output was 17% greater in 2004 than in 1994, and that of electricity was 13% greater. This might reflect a change in production to more energy-intensive methods, or it might reflect different weather conditions in 1994 and 2003. More research is required to clarify this matter.

Suppliers: Flügger also established an environmental policy and guidelines for its *suppliers and subcontractors.* This includes a grading system for its suppliers, based on their compliance with environmental regulations and eco-friendly practices.

Social Measures

Employees: With respect to its employees, Flügger introduced comprehensive training programs to empower its employees and create core competencies based on a 'bottom–up' approach. The company also invited its staff to participate actively in this work by suggesting improvements based on their own experience. Staff attitudes and general staff culture were enhanced by: (i) the use of environmentally friendly public transport; (ii) the installation of engine heaters in the staff car park; and (iii) the introduction of a salary-bonus system. The company has also invested in a video-conferencing facility to reduce the costs and environmental impact of company personnel travelling within Scandinavia.

Customers: To minimise health risks to *customers,* Flügger developed, as the first paint producer in Sweden, water-based alternatives to paints and wood oils based on organic solvents. Almost 70% of Flügger's products are now water-based, and the aim is to reach 100% water-based paint production by 2010 in accordance with European Union regulations regarding volatile organic compounds (EU-VOC). As a consequence of this strategy the company has introduced a free service that focuses on teaching lay customers how to mix paints, test them, and apply them. For professional customers, the free service tests new products and provides pertinent information about health and the environment.

In addition, the company arranges courses for its staff and professional customers to ensure a uniform professional service attitude throughout the company. These courses cater to approximately 1000 people per year.

Economic Measures

Flügger's total market share increased from 7% in 1996 to approximately 15% in 2004, and its paint market share increased to 18–20% in 2004. Furthermore, the firm's sales turnover increased from SEK326 million in 1995 to SEK475.5 million in 2003/04. In 1998 Flügger's sales of Träolja oil had increased to over 120,000 litters that are 50% of their total wood oil sale, in this matured and stable Scandinavian market.

TRM –

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Flugger's management took sustainability seriously as a core part of the company, beyond looking good, and develops and implements its business model.

Integration (different standards): Flügger's management was adopted a strategy driving by the eco-efficiency approach in integrating EMS with the existing business management systems, such as TQM and other systems in the operations management to create high performance and efficiency. The Flügger case is a good example of this integrative perspective of ISO-certification, TQM-process, and EMAS.

Descriptive/ Potential-values: The unexpected challenges faced the management of Flügger leads to an organization-wide commitment. For the top executives in the change process was a high-risk mission. If they have been set the EMS objectives and targets too low the irresponsibility act on environment from the company side had still been obvious for the market. This situation led them to choose a change agent as Miljöcentrum, coming from an environmental NGO, and how it took the job with a simple instructions of being transparent on every step to all their stakeholders and forced Flügger to adopt the EMS as a culture in the organization, must be seen as a very unusual step leads to strategic decision.

Normative/Core-values: **Flüggers'** commitment to fully sustainable transformation and to the "triple bottom line" recognizes the favourable stakeholder relationship and a devotion to broad environmental objectives. As well, the widespread recognition as a pioneer in acquiring ISO14001 – environmental and technological leadership, ISO 9001 for product quality, with a well known brand in the Nordic countries and business integrity have proved to be increasingly valuable over the long-term.

Instrumental/Value- creation: The distinctive partnerships between an employer and the employees have positive effects from being a financially solid group listed at the stock exchange to higher credibility amongst its employees and potential new employees. Flügger's management vision is to be ahead in this development and not to be exposed to any risks in particular. Hence, as part of this strategy is brand development and market share growth. Their main brands have been registered and are continuously supervised.

Reporting

Flügger was certified for EMAS in order to publish their environmental report based on their transparency agreement with Miljöcentrum in 1995, all their documents are open. As well, they submit their reports to local government and other concerned parties.

Summary

Flügger's initial decision in 1992 to change its environmental policy and reputation was born of necessity to ensure immediate survival. However, in the longer term, the many investments it has made have had the effect of placing the company in a leading position with respect to market share growth, eco-efficiency, sustainability and competitive advantage. The company's success had the effect of transforming the views of its customers the whole industry on the nature of sustainability, management, innovation, engagement and costs.

4. Discussion conclusion and further research

According to Enquist et.al, (2006) for using CSR in a more proactive way as a driving force for value creation (Norman, 2001; Prahalad and Ramaswamy, 2004) fundamental question to be asked is: value for whom? (Flyvbjerg, 2001) To comprehend the mission and vision of using CSR as a driving force for value creation to both shareholders and stakeholders Enquist et.al (2006) argue for the necessity of a deeper stakeholder analyse. Although these models neglect the role of understandings and collaborative behaviour developed over time in the long-term success (Waddock and Bodwell, 2007; Post et al, 2002). As part of this study and recommended by Enquist et.al. (2006) I applied Responsibility management of both Waddock and Bodwell, 2007 and Post et al., (2002) contributions to analyze and interpret Flüggers' case.

TRM is describes the internal codes of practice and systems that organizations are developing to manage their responsibilities-social, environmental, and ethical. This is in response to pressures from stakeholders, actors, standards, trends, and institutional expectations (Waddock and Bodwell, 2007). Flügger executives' initial decision creates a responsible organization with ethical values. Post et al. (2002) *descriptive* emphasises on the social and the political dimension of an organisation's strategic environment. But it is also highlights the value of humanitarian, ethical and behavioural aspects which are important for all types of stakeholders, in the long term success (or possibly failure) of the enterprise. The challenges put on the shoulder of the management in Flügger into fundamental changes in corporate behaviour. *Instrumental* is for a more dynamic perspective on success-drivers of stakeholders view. This view represents a comprehensive description of wealth creation process, with a special emphasis on "rational wealth", but also for potential problems (Post et al, 2002). *The normative* is of core values that have to be continuously updated and sustained through organizational learning-process. This base precedes and underlies its descriptive accuracy and its instrumental contributions to corporate success, as the stakeholder view of the corporation is fundamentally normative (Post et al, 2002). Flüggers' commitment to fully sustainable transformation and to the "triple bottom line" recognizes the favourable stakeholder relationship and a devotion to broad environmental objectives. These can also be seen in the case of H&M. Transformation process by adopting different mechanisms, and are striving now to be a sustainable company. The cases of IKEA and Starbucks can also be good examples of this level.

In assessing the generalizations of Flügger's sustainability based on the above indicated factors, I developed a framework Fig 2. Companies have to be committed and act beyond efficiency and reporting to be sustainable organization.

In order to illustrate the figure more; *Certification and Efficiency* are part of the organizational internal performances. Certifying for different standards and systems – ISO 14001 and ISO 9001 for Flügger. *Efficiency* represents technical and supervisory training augmented with interpersonal skills training. It is also asses the company's ability to integrate different kinds of standards or systems, for example, ISO 14000 integrated with TQM and other systematic approaches - an approach for total responsibility management (TRM) as described by Waddock and Bodwell, (2007).

Reporting represents the company's commitment and ability of communication with external stakeholders. In the case of Flügger sustainability report is complying with an EMAS statement and other annual reports submitted to different environmental and governmental authorities according to EMS - ISO 14001.

The Sustaining Organization is the one who can create value for both the shareholders and the stakeholders. Although it is hard to generalize Flüggers' success lead the company to being sustainable.

External Environment / Stakeholders value	Reporting	The Sustaining Organization
	Certification	Efficiency

Internal Environment / Shareholders value
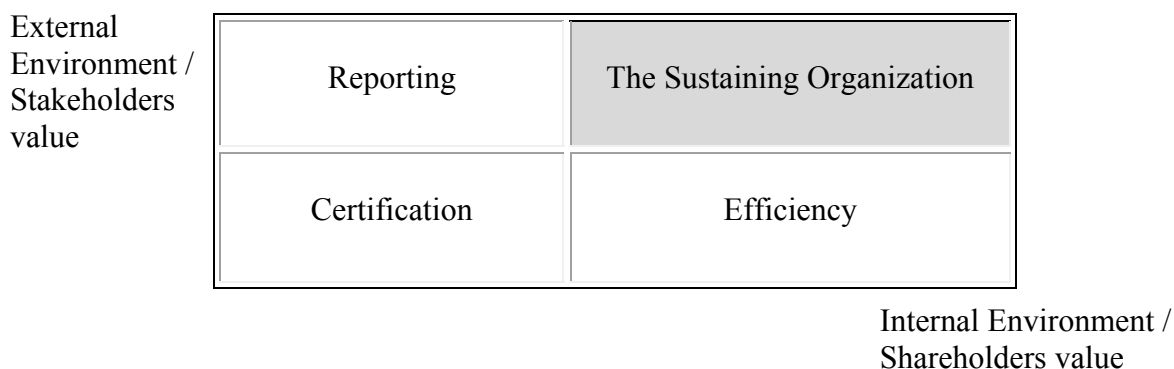
Figure 2: *The framework for process of sustainable Company*

Compliance to different kind of standards can be seen in a continuum as companies have to make continuous improvement based on the standard or system they agreed to work with or certified, such as ISO 14001 in the case of Flügger. It can also be some other big companies' way of acting sustainably, as IWAY of IKEA. At the beginning, environmental concerns stimulated corporations as a driving force to act beyond compliance; from strategies in compliance with government regulations and other concerned parties pressure to reduce environmentally harmfully outputs - to sustainable development strategies and reporting, which proactively attempts to go beyond resource conservation to assure the wellness of future generations.

Certification   development process   continuous improvement
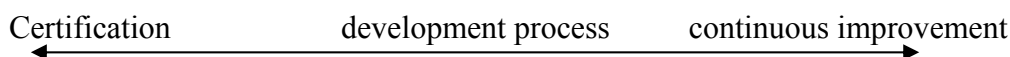
Figure 1: Compliance - a continuum of practice

Finally, the paper illustrates the importance of SPM, whereby the performance and commitment of mangers can be measured. It also illustraste that the managers have to be conscious of the importance of measuring performance both internally and externally. I argue that sustainable value creation requires more than adherence to external standards; rather, it requires a shift in mindset in order to make a proactive leap towards sustainable value. In addition, future research could examine whether these indicators could apply in other settings and cases. There is a need for in-depth research into the assessing SPM, from different perspectives, using best-practice cases as a learning base.

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An Exploratory Research Study: Operationalizing the Measurement of Failure Demand in Customer Service

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Abstract

Category: Exploratory Research, Case Study

Purpose: The purpose of this research is to test a simple model designed to measure and improve service delivery in call centers. In many countries including the U.S.A., the service component of the economy has been dominant for over 50 years and continues to grow both in relative and absolute importance. Even so, there is a dearth of literature on strategies to improve services using simple interventions. Improvement in service delivery may be defined as increased customer satisfaction and/or reduced costs. Service delivery systems are highly idiosyncratic so change or improvement must to closely linked to each system's unique characteristics. There are many academic studies reporting effective and validated research methodologies employed to measure service quality from the point of view of the customer. However, these methods of measuring service quality are complex and unwieldy and best left to highly trained academics and graduate students for implementation and interpretation. Still, competition in the market drives service providers to seek ways to continuously improve. Customers expect and wish to receive value from the service center (value demand). Some literature (Seddon, 2005) suggests that service customers do <u>not</u> receive what they expect (failure demand) about half of the time. Service providers seeking a mechanism for continuously improving efficiencies while maintaining or increasing customer satisfaction may submit their systems to the rigors of academic research, develop expertise internally, or engage an external consultant. Our purpose is to adapt the lean service concepts of value demand and failure demand from the consulting world and apply them to actual call center service operations using academic rigor.

Methodology/approach. The authors developed a checklist of best practices for call centers from the literature. These checklists were discussed with call center staff and their managers and compared to their standard operating procedures and measurement/staff evaluation systems. All participants acknowledged that this was an experiment and the results could not be used for employee evaluation. Through multiple iterations with call

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center staff and managers, the researchers developed a three part call evaluation system to include (1) value demand (2) failure demand and (3) not able to determine. This call evaluation system was used for several days. The ratio of the three categories was charted in a simple spreadsheet.

Findings: Managers of service operations are deeply interested in simultaneously improving efficiencies and customer satisfaction. Any validated tool to achieve these goals is highly valued. The findings indicated that the value/failure demand measurement system was useful and many failure demand occurrences occurred. Managers will consider improvements based on these data.

Research Limitations: This study describes a tiny sample of the service economy and is limited to direct service providers in call centers and their managers. This first step did not validate value from the point of view of the customer. This would be the next logical step for additional research.

Practical implications: Service providers need simple tools to assess operations, improve quality and efficiency. This was the first step in what we hope will be the development of an easy-to-use tool for the continuous improvement of services.

Keywords: service, quality, value, demand, failure, customer, lean

An Exploratory Research Study: Operationalizing the Measurement of Failure Demand in Customer Service

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The purpose of this research is to test a simple model designed to measure and improve service delivery in call centers. Improvement in service delivery may be defined as increased customer satisfaction and/or reduced costs. Service providers seeking a mechanism for continuously improving efficiencies while maintaining or increasing customer satisfaction may submit their systems to the rigors of academic research, develop expertise internally, or engage an external consultant. Our purpose is to adapt the lean service concepts of value demand and failure demand from the consulting world and apply them to actual call center service operations using academic rigor.

In many countries, including the United States, the service component of the economy has been dominant for over 50 years and continues to grow both in relative and absolute importance. Even so, there is a dearth of literature on strategies to improve services using simple interventions. Service delivery systems are highly idiosyncratic so that change or improvement must be closely linked to each system's unique characteristics.

One promising approach to improving service is the application of strategies adapted from the Toyota Production System (TPS) – lean production. The lean approach to service improvement is derived from the manufacturing production, so modifications of TPS are inevitable. While there are many ways to define "lean" practices, perhaps three elements appear in most definitions: (1) focus on value as defined by the customer (and value stream), (2) management of flow (including "pull" from customer demand), and (3) engagement of all in continuous improvement, (Womack 1990), (Womack & Jones 1996), (Hines, Holwef & Rich 2004), and (Mayalef 2006).

With such a definition in hand, what is the best method to apply what we know about lean practices in manufacturing and apply them to service activities? In the excellent

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review of current lean thinking, (Hines et al. 2004) commented "... We have attempted to summarise how the lean concept has evolved from production toolkit, through single supplier-customer focus dyad, to a strategic value proposition. The resulting lean value system encompasses a value-adding network of operations across companies, with the goal of providing a series of contingent value proposition to individual final consumers. This focus on the final customer is still missing in most lean supply chains, and least of all it is found in the auto industry where lean originates. The optimization of such a networked system is determined by the value created to the customer, and not by localized performance measures within subsystems, such as the factory or the distribution channel. …Further research is called for to see how this may be achieved in under-researched sectors, such as low-volume manufacturing and service environments… like health care, which are still in early stages of their lean evolution."

What is the advantage of a lean approach over one of the myriad academic systems of service improvement? These are well documented in (Swank 2003), (Johnston 2004) and (Johnston & Jones 2004), and of course the voluminous SERVQUAL literature (Parasuraman, Zeithaml & Berry 1985 and 1988). For more then twenty years, academics have been creating and refining excellent methods for measuring and improving systems of customer satisfaction and service excellence. There are, however, problems with academic approaches to researching service quality. It is now obvious that such problems do not lie in the reliability or validity of the instruments and interventions. Searching for SERVQUAL in the Emerald academic journal database alone returned 1191 "hits"; this is a well validated and widely used instrument. The problem with most academic approaches is one of scale. Developing and executing a full-blown SERVQUAL- based investigation requires a high level of staff and budgetary resources. These resource requirements and logistical barriers preclude the use of such approaches for many small and medium size enterprises.

It is widely accepted that in the most developed nations, small and medium size enterprises with a service orientation form the most promising source of economic growth. It follows that a simple form of assessing customer service could be very useful not only for the academic world but also for many potential clients in the private sector within the regions supporting public universities. This is particularly true for the authors of this paper working at a largely regional university in the Midwestern U.S. where our mission is one of service to the regional economy. The hegemony of the large automotive companies based in southeastern Michigan is broken and serious economic decline has ensued. The hope for economic stability in the future lies with small and medium sized enterprises, especially in the service sector. This study reports on research done in a call center of a company whose business model is based not only on manufacturing specialized products but also in providing service after sales.

How might service operations be improved without mounting long, expensive, and cumbersome projects using insights from lean production? Seddon (2005) uses the lean concept of working backwards or "outside in" to assess how a call center permits the customer to "pull" value from the system. This is highly consistent with the (Marr & Parry 2004) and (Parry 2004) study of Fujitsu call centers. Both Seddon and Marr &

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Parry have determined that improving service quality is impeded by, "command and control" thinking – by using the management structure inherited from manufacturing and Frederick Taylor's Scientific Management because that is what managers know and understand. Command and control work organizations work, "forward" from what managers think customers want. This approach is made rather simple by the data collected using modern call center technology. A call center manager can automatically create reports on length of time taken to answer call, percentage of calls abandoned by callers, average time call center operator stays with a customer, and so on. These are "push" measures which may not have any value in determining whether or not customers are satisfied. Feinberg, IK-Suk & Hokama (2000) lists measures which help to track call center quality. Only two of the thirteen listed measures relates to customer satisfaction. Conventional (non-lean) call center management appears to be tied to its ability to acquire data and manage its employees with this data, and not by satisfying customers. Furthermore, in their work on lean service services, (Bowen & Youngdahl 1998) comment that, "services tend to be innovation laggards". So it should not be surprising that improvement efforts in call centers tend to be additional applications of command and control thinking.

The lean model starts with value as determined by the customer. Then, the organization's flow of value should be defined by the degree to which the customer is satisfied. This is in stark contrast to a system, which "pushes" what managers believe customers want done without any contact or feedback from the customer. By applying these concepts to call centers, we determine that customers expect and wish to receive value from the service center and, the call center's work should result in an alignment of resources such that the customer may readily pull value from the system. Satisfying service customers is defined as value demand by (Seddon 2005), or as creating value by (Marr & Parry 2004). Seddon (2005) suggests that service customers do not receive what they expect (failure demand) about half of the time. Parry (2004) and Marr & Parry (2004) report that in their study of Fujitsi call centers, "40-90% of incoming service requests were entirely preventable," (no value created). Failure demand is not providing what the customer requires and as such, constitutes waste in the system.

By reducing waste (a lean principle) and creating a system capable of greater value demand while reducing failure demand, we should increase capacity. Failing to provide what the customer wants in a call center may lead managers to add more staff. We may bring in more operators to respond to customers who are not getting what they want. In contrast, by providing value (what the customers wants when they call) we should be able to increase productivity. By working backwards from customer requirements, we should be able to reduce waste. By working forward from management's view of what customer want, we are likely to introduce waste.

Setting: Our research setting is a company (Company J) in the Midwest of the U.S.A. Company J designs, manufactures, and supports a range of products destined for the recreational vehicle market. While most sales are in North America, they also maintain a presence in Asia and Europe. Their products are installed by OEMs manufacturing recreational vehicles, trailers, trucks, and marine craft. These terrestrial and marine units

may then be repaired/serviced either by local service centers (not part of Company J) and/or by individual owners. Company J has two geographically separate call centers: one is for general information and available to the public, and the other is a technical center specifically organized to deal with inquiries from service center or OEM staff. The public call center receives about 110,000 calls per year experiencing a distinct increase starting with warm weather in the spring, and a decrease with the onset of winter. In the late 1990s, Company J initiated a lean production effort in their manufacturing sites. As a result of the familiarity with the benefits of lean, managers were very receptive to the authors' suggestion that lean thinking may be useful in the improvement of call center performance.

Methodology: This is an exploratory research project executed as a case study. After an initial meeting between the researchers and the call centers' manager, the manager provided the data generated by the system itself. As expected, this included: number and length of calls, time of calls, average time before call answered, abandoned calls, percentage of calls answered within X seconds, calls answered by operator, average time of call, etc. Also, the researchers were given data relating calls to specific products. The manager had a thorough understanding of her systems, their technological capabilities, and the people who work in them. The data provided was essentially "push" data, with no information relating to the resolution of customer concerns.

Attempting to work "outside" in, the researchers set up a meeting with the manager and the most experienced call center operator. Our goal was to measure the degree to which each call was resolved or value created. After some conversation to actually see the headquarters call center and understand the nature of their work, the researchers proposed the development of a process map to further our understanding of what happened when the phones rang. This method was consistent with our understanding of tacit knowledge in organizations and the link between tacit knowledge and the lean "outside-in" approach to understanding and improving organizations.

As indicated by Bellamy and Tucker (2006), and derived from (Nonaka and Takeuchi 1995), there are two identified types of knowledge in organizations: tacit knowledge and explicit knowledge. Tacit (from the Latin tacitum, meaning silent) knowledge is intuitive knowledge that may guide our actions successfully even though we are not fully aware of its source or effect. Explicit knowledge refers to knowledge that is easily identified and codified by the organization. However, "tacit knowledge is the force that enables explicit knowledge. It is therefore the critical source of information that organizations must find ways to enable in order to boost their competitive power," (Bellamy & Tucker 2006). Using Seddon's (2005) approach of "outside in" the researchers will focus on gathering and organizing data from the call center operators. Lean thinking is both built on and a reaction to Frederick Winslow Taylor's Scientific Management (Seddon 2005). Taylor believed that he could codify tacit knowledge and control it as explicit knowledge thereby dis-empowering the workers, the source of tacit knowledge. Taylor is reported to have said in 1906, "Any improvement which the workman makes upon the orders given him is fatal to success" (MacDuffie 1995). In contrast, understanding tacit knowledge means that information critical to the organization's success is located only with the

worker and may or may not be documented anywhere else. Taylor attempted to remove the knowledge from the worker and create work standards as the purview of management thereby alienating the worker. Our operating assumption is that the tacit knowledge will be willingly proffered if the worker is given the opportunity to engage in improvement activities which do not threaten their position.

Also, Hines et al. (2004) in their review of lean thinking, suggest that, "organisations … miss the strategic aspect (value creation, and understanding customer value)" of lean while focusing on cost and lean tools. Thus, starting at the interface between the company and the call center customer should focus our efforts on value creation as determined by customers. By operationalizing the tacit knowledge found among the operators via the process map, we should be able to develop a mechanism for capturing data relevant to value and failure demand. The process map did illuminate the practices of the operators known (tacitly) to them and to their manager but his information had never actually been captured before. A process map was developed on the whiteboard in the call center itself and then photographed so it could be transferred to the computer and used for data collection.

The call center operators identified tiers of interaction starting with the incoming calls based on their tacit knowledge base. They defined the entry level to their system at the simplest level. They shared the fact that there were two distinct categories of calls coming into the call center: logged calls and not logged calls. This is a key component to the data collection and analysis for Company J. When presented to the manager the researchers were informed that the system of Company J allows the operator to determine if the call should be logged or not. This decision of allowing the operators to make a determination was made by Company J to allow the operators to best meet customer needs and not clog the reporting systems with calls that are perceived to be already resolved or, in our research term, considered to be value demand calls. These calls are seen to only require a simple exchange of information that is sought by the customer and thus meeting value demand in Company J's view. Thus, operators log calls based on the type of request from the customer. The not logged calls fit into customer requests for information such as location and contact information of the service centers, transfer calls to other internal numbers, technical center referrals and part numbers. In addition, there is a category identified as other, which contained various odd issues that were also not considered worthy of being logged.

Calls logged from Company J were contained within various product categories. These categories largely reflected customer service warranty issues, ordering of parts, various product faults, referrals, and callbacks required because the calls could not be resolved on the first call by the customer. These calls represent the larger function of having a call center according to Company J. The call center operators made no designation as to the status of the call being resolved or the identification and creation of value demand. Upon discussion with the manager all logged calls with the exception of callbacks, are considered resolved or, in our research term value demand. The process map showed additional evidence to management that unresolved calls may suggest that failure demand is occurring. Thus, it reflected that within both the referral and call back categories failure

demand is highly likely. The percentage of calls that fell into callbacks and referrals was 54% of the total calls logged and may be construed as failure demand versus value demand. This holds true to Seddon's suggestion that service customers do not receive what they expect (failure demand) about half of the time.

Another major finding was contained in the process map. The manager was very concerned about the areas and volume of the calls not logged and felt that this may be a systems error of the organization for reporting purposes. The not logged calls showed that they were approximately 3.73 times the volume of the calls being logged, thus the uncounted calls are the bulk of the interaction with customers. This reflects that the volume of work done by the call center was unaccounted for in Company J's management system. It also bring to light the question, are these calls a part of the 40% to 90% of incoming service requests that are entirely preventable that (Marr & Parry 2004) reported.

The process map and call center operators' tacit knowledge was responsible for providing a new visualization of what was happening in the customer service call center in Company J. The process map and the information gleaned from the process map has helped the manager to see the relationship between traditional call center management (activity tracking) and customer demand management (value and failure demand tracking). The manager has agreed with the researchers to continuing the study. We have created and establish an agreement on a method for tracking failure and value demand using the terms resolved or unresolved in the reporting process by the call center operators. This method will be used on all the calls being logged by Company J.

The mapping process allowed Company J and the call center manager enough initial data to assist in their understanding of the various aspects that are required to measure value and failure demand. In addition, it allowed the manager to begin the conceptualization of creating a call center management system that reflects and compiles the aspect of customer demand. We can now specifically target the failure and value demand capability that was lacking in Company J. The biggest revelation to the manager and Company J was the significant amount of calls that were not being measured or accounted for in their approach in any form because they were not logged.

Further research is currently being conducted at Company J at both their technical and customer service centers that will show more clearly if they meet their customer's demands.

Practical implications: Service providers need simple tools to assess operations, improve quality, and efficiency. This was the first step in what we hope will be the development of an easy-to-use tool for the continuous improvement of services.

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Investing to Improve - Organisational Development and the link with Lean for Continuous Quality Improvement

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Abstract

Originality/Value of paper

HE sectorial evidence and case study relates mostly to established CQI in US universities and colleges based on Baldridge award criteria but with Lean tools now beginning to be used. Several UK universities are investigating the applicability of Lean as a CQI approach. However, no specific evidence has been found for the use of Lean driven by and through organisational development and the improvement of leadership competency to deliver tactical improvements linked to strategic requirements. Thus this reported work is original and would be of interest to the HE sector and the public sector more widely.

Purpose

In the face of global competition intensifying the need for high-level skills and knowledge and growing competition for students, the demands being placed on universities is increasing. These demands are also rising in complexity, from the growing number of stakeholders e.g. students, businesses, the public sector, society and government, and in their varied requirements, for example, in the variety and diversity of provision and in the use and development of new technology.
This paper will describe the strategic response that Coventry University is making to address these demands. In particular the way in which 'customer value' is being recognised and steps taken to 'added value' efficiently and effectively throughout systems, processes and work streams through the use of Lean principles, tools and techniques for continuous quality improvement (CQI).

Methodology/Approach

Experience in other sectors has shown that for CQI to be developed and sustained requires a methodology that does not focus simply on the use of improvement tools but includes a longer-term emphasis on development, leadership and cultural change linked to corporate strategy.

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Recognising these guiding principles Coventry has embarked upon the implementation of an extensive Leadership programme (LDP) involving over one hundred key staff and from this the formation of leadership Action Teams (LAT's) to undertake improvement projects identified for their strategic importance to the corporate agenda.

Findings

An LAT pilot project, described in the paper, was undertaken to improve the staff approval and recruitment process. Lean tools, in particular Value Stream Mapping (VSM) were used to identify the customer pathway and deliver improvements. The result is a streamlined process with less documentation which is significantly easier to complete. Representing an improvement of 54% in time to process and a 42% reduction in value added time.

Keywords

Strategic, Development, Competency, Quality, Lean, Value, VSM.

Paper Type

Excellence in Higher Education

Category: Case Study

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Introduction

As we move further into the 21st century, organisations have to increasingly align their operational activities with their strategic plan in order to achieve the desired competitive advantage. More recently universities in the higher education (HE) sector within the UK have begun to do this and to adopt the principles tools and techniques established in other business sectors to realise the desired change and improvement. This is predominantly due to increasing competition within the HE sector, the increasing number of mature students, the sizable population of part-time students, the requirement for change in the pace and place of learning, the integration and use of new technology, the necessity to provide a rewarding student experience, the student expectation of a good graduate level job at graduation and increased involvement in applied research. In addition the introduction of a variable tuition fee (in England and Wales) has affected the willingness of students, as customers, to pay a higher rate. This depends on a number of core factors include; quality (perceived or measured), flexibility and the facilities that are provided. To exploit this opportunity universities have started to focus on organisational development that will constitute towards operational efficiency that focuses on meeting customer satisfaction.

From an investigation of published literature in the broad areas of total quality management (TQM), continuous improvement (CI) and Lean one guiding principle for cultural change and sustained success in CI seems to prevail namely; that it should involve an holistic top-down implementation, with a strong relationship developed between the corporate plan and the 'key' strategically aligned actions. The above approach has been successfully applied within manufacturing organisations and has more recently emerged as an approach appropriate to the public sector (Radnor et al, 2006). This same approach is now being applied within universities in order to leverage the same benefits that the manufacturing sector has enjoyed. It has been shown that the tools and techniques cannot, in most cases, be directly applied due to the differences in the operational framework of the sectors (Radnor et al, 2006) however, from the limited published work available (Alp, 2001), (Emalini, 2005), (Emalini, 2004), (Emalini, 2004a) and (Wiklund and Wiklund, 1999) it is clearly feasible to adapt lean principles and practises from the manufacturing sector to that of education. While it remains important to make use of the transformational tools, with their emphasis on reducing waste and improving quality, for sustained improvement attention needs to be paid to addressing prevailing beliefs and behaviours. For example, the development of leadership in middle management has been identified as a requirement for the alignment of tactical responses to strategic requirements (Martin, 2001). This involves training and development in not just the CI tools but is likely to include changes in how performance is recognised and rewarded (Emalini and Stec, 2005) for sustained improvement the emphasis therefore appears to centre on developing a holistic approach to the implementation of Lean (Bhasin and Burcher, 2004), (Hines et al., 2004), (Ligus, 2007) and (Zink et al., 2008).

Framework

Recognising this guiding principle Coventry has embarked upon the implementation of an extensive Leadership development programme (LDP) involving over one-hundred key staff from throughout the university. LDP topics cover a wide range of business related areas including performance management and employment law, finance fundamentals for HE leaders, leading with impact and influence, customer

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relationship management, managing difficult conversations, working with the press and media as well as a host of additional awareness raising events. Participants of this programme have become members of Leadership Action Teams (LAT's) who are undertaking improvement projects identified for their strategic importance to the corporate agenda.

Figure 1 diagrammatically represents this approach to delivering improvement benefits where the executive will sponsor an LAT to review and improve a process or system that involves often many of the functions within the university and if successful will impact on one or more of the areas of focus in the 2010 corporate strategy.
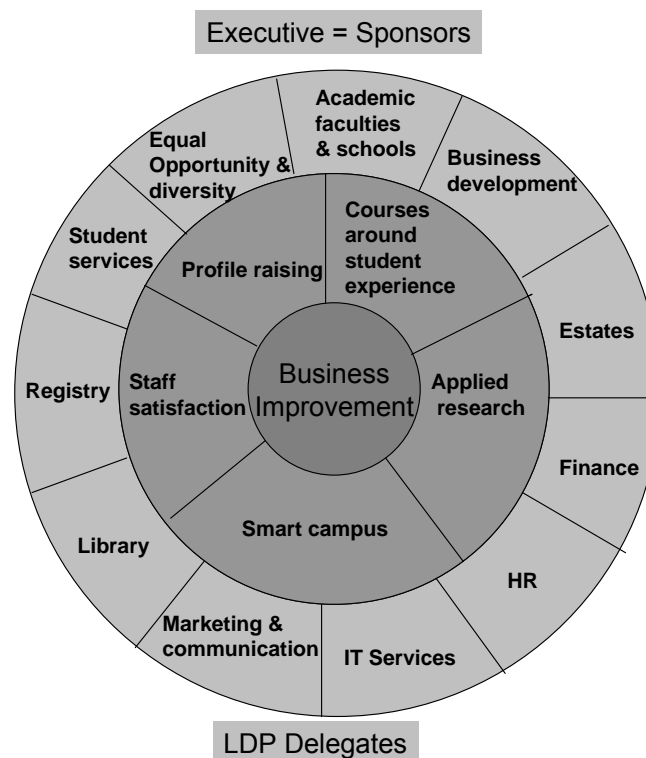
Figure 1: Process improvement strategy

This paper describes a pilot project undertaken to improve the staff approval and recruitment process. The aim of this project was to review the current approval and recruitment process and action changes that would reduce significantly the time taken to recruit additional or replacement staff. Achieving this would impact in a number of areas most notably staff satisfaction, student satisfaction, applied research and profile raising.

Applying Lean Concepts to the Staff Approval and Recruitment Process
To accomplish this work, lean tools and in particular Value Stream Mapping (VSM) were used to identify the customer pathway and deliver improvements. The result is a streamlined process with less documentation which is significantly easier to complete. Representing an improvement of 54% in time to process and a 42% reduction in value added time. The details of this work are presented in the following section.

This project was sponsored by the human resource (HR) director and included a rapid improvement event (RIE) conducted over two consecutive days. The team, made up of eleven participants, was carefully selected such that it composed of various roles and responsibilities throughout the organisation. The participants were drawn from HR recruitment team, suppliers (external recruitment agencies), IT services, and customers drawn from library services, academic faculty and student services who during the workshop period, and indeed after it, were empowered and encouraged to access the wider resources available to them. The RIE a mixture of trainer led-learning in the methodology and simple tools and techniques to be employed as necessary, and participant led improvement activities was divided into activities as illustrated in Figure 2. where day one was designed to deliver a map of the current process and identify areas for improvement and day two would build the future state map through the elimination or reduction of the wastes identified in the current process.
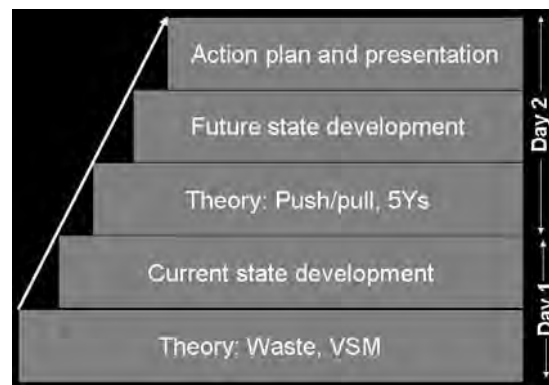
Figure 2: Structure of the RIE

The workshop was started by introducing the general principle of non-value added activity with respect to the service environment. The participants also had the opportunity to practice a number of short exercises that made them conversant with the basic principles of lean. This provided them with a clearer understanding of value stream development featuring a service type example. The next stage was the development of the current state map for the recruitment process. The main development work was conducted by the participants with guidance from the trained internal facilitator where necessary. Figure 3 shows the current state map in development.
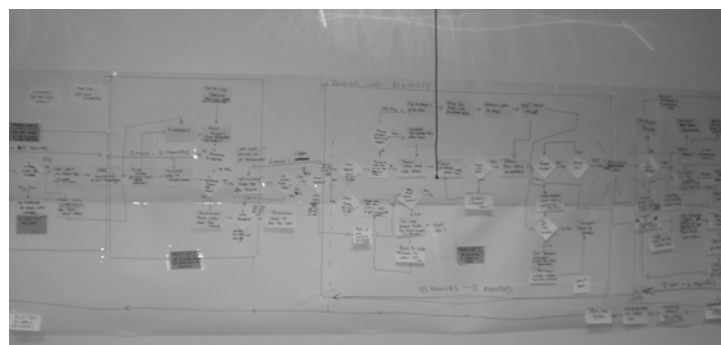
Figure 3: Development of the current state map for the recruitment process

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The development consisted of identifying the main tasks and the function with responsibility for completing it and finally attaching a time element for both value added and non-value added element of the activities. Allocating the time element proved to be of some challenge due to the variability of the tasks involved. In light of this variability average times were agreed. Despite the need for this the lead-time calculated from the value stream map corresponded well with the to previously recorded recruitment lead-time provided by a number of the participants involved. The value stream map when completed provided a good representation of the issues faced within the recruitment process.

With the aid of the value stream map the participants were able to apply the seven-wastes concept to identify the non-value added activities in the process. Some of the key wastes identified at the macro level included the following:

- Waiting for signatures
- Preparation of job advertisements
- Coordination of information
- Short listing process
- Organisation of interviews
- Confirmation of pre-employment checks
- Preparation and sending out of contract documents

Applying the Lean principle of allowing the customer to pull and the 5-why's improvement tool simplification and streamlining of the current state through the use of parallel processing where possible, better method of coordination between the various departments, elimination of duplication of activities, minimisation of transport by use of electronic means where possible, use of pull system in conjunction with the use of required-by-dates to prevent overproduction as well as unnecessary work in progress, provision of additional training and systems that embraced standardisation where applicable to minimise rework during the various stages and simplifying activities without the compromise on quality standards to cut down time that was consumed due to over-processing resulted in a future state map in which the lead time to approve and recruit a new member of staff was reduced by 54% from 96 days to 44 days and the time taken to add value within this process was reduced by 42% from 6 days to 3.5 days as shown by Figure 4.

The final stage involved putting together an action plan and delivering the achievements of the workshop along with the implementation plan to the executive sponsor. Key items on the action plan included the following:

- Approval of AP forms in the absence of executive staff
- Use of email to send applications between functions
- Purchase and use scanner
- Develop and use new approval form
- Develop useful templates
- Negotiated turn around time for approval with finance
- Establish a system that will allow effective coordination
- Pre employment checks
- Accessibility to clients
- Higher capacity answering machines

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- Evaluation of suitability of current processing software
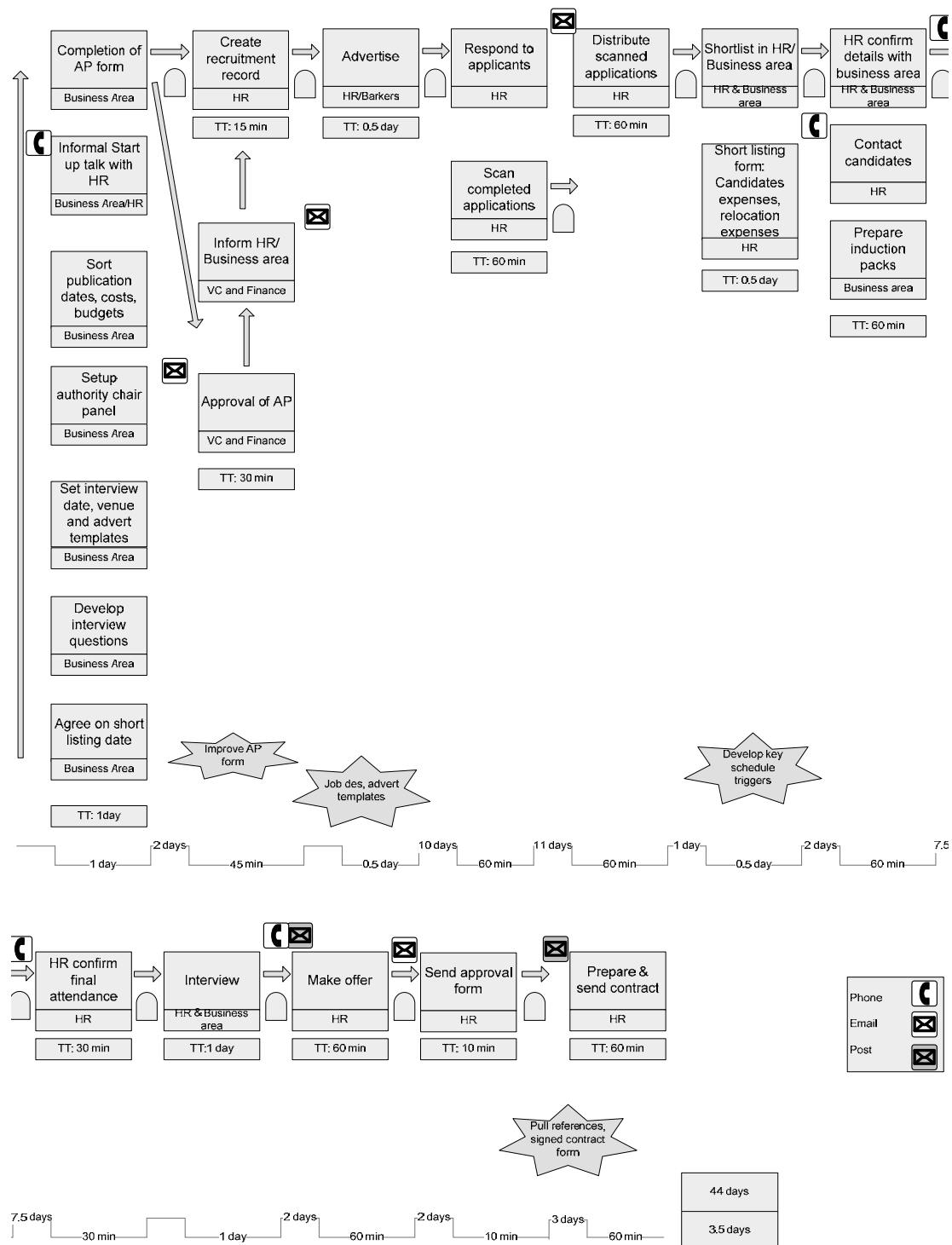
Figure 4: The future state map of the recruitment process

The actions were also prioritised as illustrated in Figure 5. where extent of impact on the process efficiency and ease of implementation were considered in prioritising actions.

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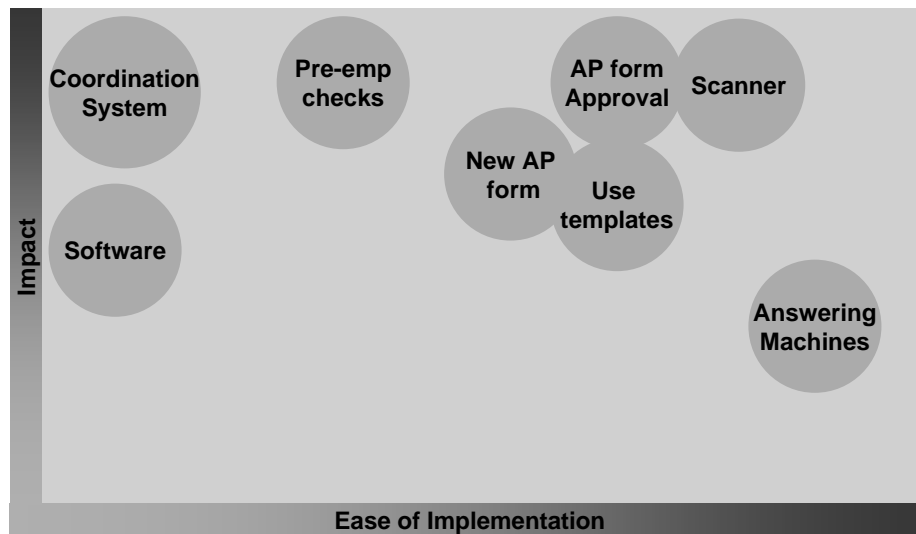
Figure 5: Prioritising the implementation of identified tasks

Team participants took responsibility for actions and completion dates were agreed. For many of the actions identified the executive sponsor was able to provide immediate approval or approval within a relatively short time-frame however, as might be expected certain proposed actions required approval from other areas of responsibility. In particular agreement to the selection of software to automate many of the process stages which would need to integrate within the university's IT strategy and would require a significant level of investment was noted but considered outside the scope of the improvement brief.

Periodic review at 30-, 60- and 90-days after the RIE was agreed and revealed challenges associated with completing and closing off agreed actions. The following reasons for the partial or incompletion of some of the actions have been cited:

- Lack of a recognised process owner driving results achievement, maintaining momentum and overcoming obstacles
- Pressure to complete day-to-day activities where competing priorities and demands impinge on the ability of individual participants to sustain focus
- Delay in approving actions that involved agreeing policy changes
- The complexity of software solutions that impinge on the effective operation of other areas of the business

Despite these challenges actions implemented to-date have resulted in a 20% reduction in the overall time taken to approve and recruit a new member of staff.

From the pilot study undertaken, it can be seen that there have been a number of challenges faced in the timely achievement of the desired result and thus the extent to which this particular change will support the corporate objectives. Generally where process changes to the value stream were proposed that were within the control and

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responsibility of a functional area these were acted upon. However where changes proposed affected a number of functional areas i.e. changes to end-to-end processes, the lack of ownership, responsibility and authority becomes an issue. One should also recognise the operational differences between the manufacturing sector, particularly where repetitive manufacturing is practised, and HE where variety in activities and demand cycle determine the specific tasks being undertaken and prioritised at any particular time. If this is coupled with the degree to which different parts of the organisations activities and priorities are actually synchronised it emphasises the fact that though the principles of Lean may apply the methodology, tools and techniques cannot simply be adopted but will need to be adapted for use within the HE sector.

Conclusion

This paper has provided an overview of the increasing competition between organisations and more especially the higher educational sector and the increasing importance of CI in order to maintain competitive advantage. Lean has been identified as appropriate to the public sector and this paper has cited a number of existing publications to support this assertion. Further an original case study of a Lean improvement activity has been referred to within this paper and the approach taken and the tools used have demonstrated that Lean can deliver measurable improvement to a process. However, through the challenges that implementation exposed it has also revealed the gaps in knowledge that exist in order to deliver Lean in a holistic way and to sustain it, this despite the work done already within Coventry University to align tactical interventions for improvement with the strategic business requirements and more research into this emerging application is needed.

Organisational culture as embodied in individual beliefs and behaviours, existing organisational structure within the HE sector and the diversity of institutional focus may make it impossible to develop a unified approach to Lean improvement within the HE sector however, as more universities engage in the use of Lean as a way of delivering improvement, and as these become known, proven strategies should emerge and adapted tools and techniques should appear to assist the quality improvement process.

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A Note on Failure Mode Avoidance

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Abstract

Category

Case Study

Purpose
To enable failure mode avoidance it is necessary to understand when and why potential failure modes are created. The purpose of this paper is to understand when and why potential failure modes are created, to create a better base for failure mode avoidance.

Methodology/Approach
This paper is based on a study of ten customer related reliability problems in an automotive company. The interviews were all based on open-ended questions that facilitated the interviewees to give narrative descriptions of their views and experiences. In total 13 interviews, each between one and two hours, have been performed and secondary data has been used as a complement.

Findings
The cases analysed are all customer related problems; meaning that the failures were detected when the product had been introduced in the market. However, a majority of the failure modes were created in early development phases. Many of the failure modes that eventually occurred in customer use had their cause in the concept development and selection phase. A costly time gap seems to exist between failure mode creation and failure mode detection. The research in this study indicates that this gap could probably be minimized and faults avoided through a more proactive failure mode avoidance work.

Research Implication
This paper calls for a change of mindset in the work to improve reliability; a change from a focus on failure mode detection to failure mode avoidance. This implicates a need to frontload the product development process in terms of reliability enhancing efforts.

Originality/Value of paper
For researchers as well as practitioners in the field of reliability this paper offers an insight into current industrial practice in this area, revealing areas in which further research and development is needed. The findings of the paper will hopefully facilitate a shift in reliability practice from work on failure mode detection to work on failure mode avoidance.

Keywords
Failure Mode Avoidance, Failure Mode Detection, Reliability, Robustness

1 Introduction

Clausing (2004) define reliability failure modes as any customer-perceived deviation from ideal function of the product. Further, Clausing (2004) and Clausing and Frey (2005) outline two main causes of failure modes: lack of robustness and mistakes. Both mistakes and design decisions that lead to lack of robustness can occur during all stages of product development. In other words, associated with all product development, and all its stages, is the creation of potential failure modes.

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Naturally, there are a lot of efforts made to avoid failures and failure modes. An example of such an effort is reliability engineering and its related methods (for an overview see IEC 60300-3-1 (2003)). These methods, e.g. Failure Mode and Effects Analysis (FMEA), aim at identifying potential failure modes and if necessary initiate appropriate countermeasures so that they stay potential and do not eventually become real failures. Thus, in summary reliability methods aim at preventing failures, as outlined by Clausing (2004) "reliability is failure mode avoidance."

In the preventing spirit is also an underlying assumption of reliability methods as being proactively used. Proactive is defined in Oxford English Dictionary as something "that creates or controls a situation by taking the initiative or by anticipating events (as opposed to responding to them)." In literature on quality and reliability improvement proactive work is regarded as desirable; see e.g. Clausing (1994), O'Connor (2000, 2002), Davis (2006a). However, proactive use of methods can be distinguished into two groups. The first group concerns identifying and executing a solution to a potential problem, before a fault occurs. The second group is to foresee potential failure modes and prevent the failure mode from being created. In this paper we refer to the first group as proactive and the latter as genuinely proactive. Figure 1 provides an illustration of these concepts.
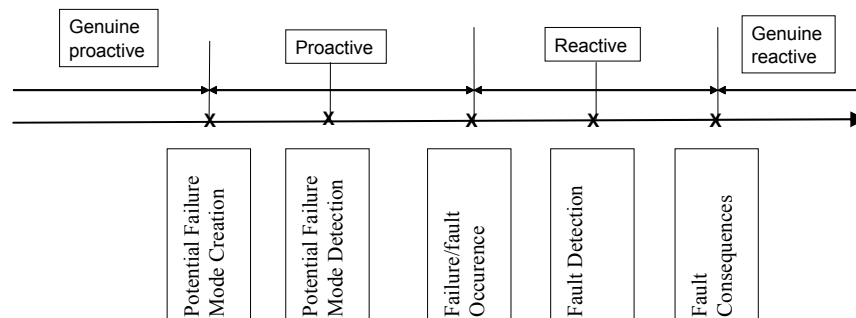
Figure 1. Categories of countermeasures related to failure/fault development. Failure Mode is the termination of the ability of an item to perform a required function, fault is the state of an item characterized by inability to perform a required function (according to nomenclature in IEC standard). Thus, failure is an event whereas fault is a state.

Thompson, Liu and Hollaway (1999) state that reliability analyses tend to be applied in the detailed design stage in order to verify the reliability of the product. The emphasis on verification gives rise to a thinking of reliability efforts applied in a reactive manner. Davis (2006a) also state that many failure modes are detected well after the drawings have been issued. He further states that "at this stage, failure modes are easy to find, but they are hard to fix because the latitude to take the proper counter-measure is severely restricted."

To enable a genuinely proactive work it is necessary to understand when and why potential failure modes are created. As expressed in Davis (2006a) the focus of reliability efforts should be "directing the actual failure modes themselves (the *how* and *why* of things failed), rather than the consequences of the failures after they have escaped into the field". The purpose of this paper is to understand when and why potential failure modes are created, to create a better base for failure mode avoidance.

2 Method

This study is based on interviews with persons involved in product development at Research and Development (R&D) departments at a company in the automotive area. The interviews

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were all based on open-ended questions that facilitated the interviewees to give narrative descriptions of their experiences (Silverman, 2001). Cases selected as subjects for interviews were development assignments that had been pointed out as causes to customer related concerns. The cases were all selected from one specific development project that shared several system solutions with other brands within the same company group. This means that the investigation was not strictly limited to product development at the company investigated but also includes its collaborators like other brands within its company group as well as suppliers.

At the company there is a special follow up fleet of early production vehicles for new projects, where all customer related concerns are reported by the drivers. The follow-up vehicles are normal production cars, i.e. no prototype vehicles, and the drivers are employees who use the cars in their daily life but have a special assignment to report all types of experiences of the car. Here, experiences can refer to any type of problem, experienced or even ideas or fears of things that might go wrong. The idea is that the concerns shall represent viewpoints of customers in general.

Connected to the follow up fleet is a special workshop that is used for all maintenance, problem analysis and repairs of the follow up vehicles. The information from the workshop activities is stored together with the customer related concern. If any corrective action on the car model is required, the concern will also be registered in a problem follow up system used at R&D.

The problem follow up system was used to select cases to study and to identify interviewees. More precisely, ten customer related reliability concerns, registered in the system, were studied. Technical information on the concerns were provided by the vehicle follow up system whereas the problem follow up system made it possible to find interviewees. Referring to Figure 1 above, these concerns were all identified through "fault detection", i.e. the failure had occurred and it is worth noting that by selecting concerns in this way the study only covers problems that were detected in late phases of product development.

The ten concerns were selected on the basis of being reliability related problems in areas interesting for the company. The cases were also selected in such a way that all main areas of the vehicle were covered, i.e. powertrain, chassis, electrical and body and trim. For each of the cases at least one interview has been performed. In total 13 interviews, each between one and two hours, have been performed. During this study no interviews were held outside the company under study, e.g. with suppliers. Although the intention of the study was to get the interviewees personal view of what had occurred, this has to be kept in mind when the result is analyzed, evaluated and interpreted. In some cases additional information from other sources was used as a complement, e.g. internal communication that had taken place when the fault was detected.

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3 Results

Since all the problems selected for this study had been detected in a late stage of product development, none of them belong solely to the "foresee and prevent" category. However, as will be discussed below, many of the problems had a possibility to be prevented before they occurred.

3.1 Detection of Failure Modes

As already mentioned, the cases studied have been chosen from a database containing various concerns with cars from serial production. Thus it is by the selection process per se given that the failures or concerns have been detected in connection to, or after, start of production. However, the empirical study reveals that there are cases in which prerequisites for proactive work existed, but this possibility was neglected. In other words people working with the product had knowledge of a potential failure mode and ideas of how to prevent a failure, but by various reasons the preventive work was hindered.

In one case a component was bought from another automotive company mainly selling their products in a different geographical region. The component was not adapted for varying fuel quality; the fuel in certain regions could cause a failure of the component. Technical experts in the company knew about the potential failures and advocated that further investigations were necessary. However, they felt that the decision makers did not want to listen to their concerns as the contract for this component was already signed. The failure later occurred and corrective actions had to be taken after start of production.

Another similar example concerns a disturbing sound from a component that was detected in the development phases. In this case one reason not to take corrective actions in a preventive mode was time limitations. In other cases, the pressure of short development time limited the number of tests of various user conditions. Thus the concerns slipped through the development process and were not formally detected, i.e. registered in the problem follow up system, until after delivery of the cars.

3.2 Failure Mode Creation

Looking at the creation of failure modes it is important to be aware of that one problem might have many interacting causes, created at different times. In the interviews the interviewees have given their perspective of the creation of failure modes, often focusing on what they consider to be the main cause. Based on the interviewees' statements, four phases in which failure modes are created has been identified (see Figure 2 for a graphical overview of these phases).

Several causes are connected to the *concept development and selection* phase. The actual problem was often not visible at this stage but occurred in later phases e.g. a selection of a concept that could not work under exceptional conditions of use. Examples are insufficient capacity of drainage systems or components too sensitive to variation in fuel quality on different markets. In some cases problems occurred due to selection of components with a lower reliability performance; components that had to be chosen as a consequence of the system solution selected. For example a selected sealing system required a specific type of seal, once in use the test customers discovered that this type of seal gave rise to unacceptable levels of disturbing sounds under certain circumstances.

The second phase where failure modes are created is during the detailed design, the *system and component design* phase. These problems were caused by failure modes/mechanisms that are often known to the engineers. However, the systems are complex and it is difficult to keep control of all factors influencing the system. Examples are problems related to the climate control system or the comfort of the brake system. In one of the cases studied the possible

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failure modes of a system were known to the engineers and taken care of in their design. However the system they designed was affected by many other components and during the product development process another design team had problem with their component and changed it accordingly. This change in turn gave rise to the failure mode affecting the system studied.

A third phase of failure mode creation is related to changed properties of components when they are transformed from prototype parts into production parts, thus this is a cause related to the *process design* phase. Parts produced in the serial production processes showed a higher degree of variation in e.g. dimensions than the prototype parts. Examples are a component in the climate system that was out of specification once in production, and problems with geometry that caused air leakage.

In some of the cases unexpected problems occurred at *start of production* that caused parts and components to be out of specifications. This was a fourth phase where problems were created.

3.3 Views on Failure Mode Avoidance

During the interviews the interviewees were encourage to come up with proposals on how the failure mode could have been avoided. These proposals can also be looked upon as a way to gain knowledge on possible causes of the failure modes.

A number of failure modes arose because robustness properties were not considered during concept development and selection, e.g. variation in market conditions were not taken into consideration when selecting components for an engine. Other examples are difficulties, during the system and component design phase, to identify how sensitive a design solution is to noise factors. Another type of variation is piece-to-piece variation for parts produced by a serial production process; this type of variation has contributed to create the failure modes in some of the cases studied.

Proposed preventive actions related to the failure modes discussed above, focused on a need to strengthen the awareness of variation and robustness. The interviewees suggested a more frequent use of robustness studies in due time, both theoretical and practical, and to include more variation and robustness consideration in testing activities. However, a limit to the use of robustness studies is stated to be insufficient data on reliability and robustness that could be used to guide engineering decisions.

One source to the creation of failure modes is when a component or system, for some reason, has to be redesigned during late stages of product development. Those situations are often characterised by time pressure, which limits the time accessible for verification and testing. In one of the cases studied a corrective action to a minor audio problem was not totally verified because of lack of time, and a new failure mode connected to the corrective action was created but not detected until after production start. Actions proposed to prevent lead-time related concerns was to assure that the development process allows for redesigns, and to assure that redesigns are tested and verified in the same manner as the original design.

Many of the studied designs are made by suppliers and failure modes are created because of insufficient interaction between the supplier and the company. An example is that the original agreement is strictly followed by the supplier although indications of a failure mode called for a new approach. Another example is when a component suddenly does not fulfil the specification because it had been changed relative the prototype parts that previously had been tested and approved.

Actions proposed for the supplier interaction concerns are to increase the openness on technical issues like the requirements or expectations on a certain type of component, on the

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technical bases for choosing a concept, as well as ensuring flexibility to react and initiate countermeasures if something unexpected occurs during the development.

4 Analysis

As stated in the introduction the purpose of this paper is to understand when and why potential failure modes are created. As a starting point for the analysis of our data Figure 2 graphically illustrates the interviewees' views on failure mode creation. The point of failure mode creation is related to phases in the development process and the thickness of the lines gives a rough indication of the number of causes represented by the line.
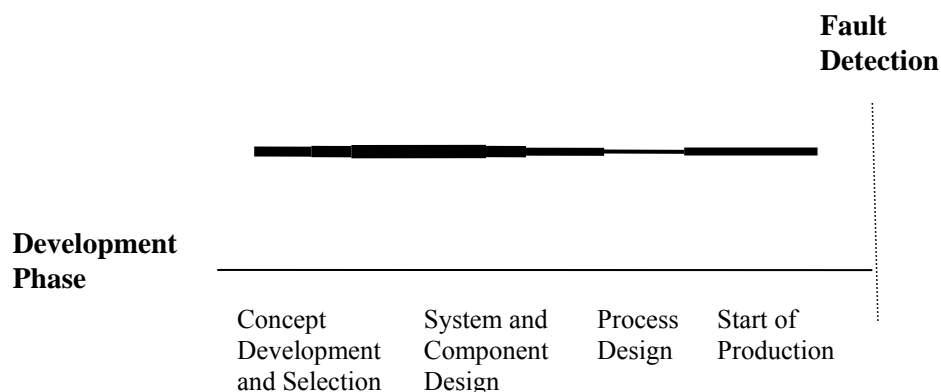
Figure 2. Estimated point of Failure Mode creation, based on interviewees' statements, the thickness of the lines is a rough indication of the number of cases represented by the line. The dotted line shows the time of fault detection, due to the selection of cases only faults detected after start of production have been analysed.

Looking at Figure 2 there is a tendency that failure modes have their origin in early development phases. Many of the failure modes that eventually occurred had their cause in the concept development and selection phase. This tendency points to a need to frontload the process, both in terms of resources and in terms of reliability enhancing efforts. The argument often used for the need of front-loading is related to the cost of corrective actions, as stated in Clausing (2004) "[Reliability] improvement means increasing robustness and reducing mistakes early in the development process, when changes are cheap to make." Interestingly, the cases presented in this paper does not merely give support for early reliability work as a means to decrease costs but also as a means to diminish failure creation with consequences in later stages of product development and in the field.

The benefits of applying reliability enhancing activities early during product development have been pointed out in e.g. Clausing (2004) and Davis (2006b), anyhow it seems as in the practical cases studied the work on failure mode avoidance is still to a large extent centred on the correction of already occurred failures. This is resource demanding in two ways; first it is more difficult to change a solution in later phases and, secondly, resources have been applied to develop solutions that might have severe inherent failure modes and later need to be radically changed. In summary a time gap seems to exist between failure mode creation and failure mode detection. This gap could be minimized through more proactive failure mode avoidance work.

It is important to point out that there are cases in which the gap between failure mode creation and detection was small. However, despite knowledge on the failure mode, corrective actions have been delayed due to time pressure in the development process. Examples are cases in which time for tests have been too short, or cases in which the interviewees has felt that

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management did not support in-house resources to work on failure mode avoidance related to bought components.

Many of the interviewees state that an active work on variation reduction by improving the utilisation of methods related to robustness and reliability could improve the proactive work on failure mode avoidance. This is supported by the interviewees' views on variation and lack of robustness as common causes of failure modes.

An important aspect to point out is that part of the cases studied, as mentioned earlier, concern components purchased from an external supplier. It seems as it is in those cases even harder to apply proactive failure mode avoidance work. It is in the cases of purchased components harder to control what kind of failure mode avoidance work the supplier has applied. Even though there are requirements on application of certain methods as e.g. Failure Modes and Effects Analysis the level and maturity of application is harder to control. Overall the interviewees' seem to have a view that the company has higher demands on components produced in-house than on purchased components. This experienced lack of control gives rise to situations when the failure modes are detected as late as when the component is supposed to function in serial production.

5 Discussion

It is important to once again point out that the selection of cases through the problem follow up system has taken away the possibility to identify cases in which proactive or genuinely proactive work were applied successfully. In all of the cases studied the faults were detected after start of production. However, the cases studied and the reasons that the potential failure modes were not identified in a proactive manner could provide ideas for prerequisites for proactive and genuinely proactive work.

Looking at the findings from the cases, it is on an overall level important to emphasis the need of early application of quality and reliability enhancing efforts; this to be able to reduce the time gap between creation and detection of potential failure modes. Such a reduced gap would also decrease the time pressure when taking corrective actions, and enable better reliability assurance in the case of necessary redesigns.

An interesting question for further study is if this decreased time gap can be achieved through accurate use of current "state-of-the-art" methods; or if current methods needs to be modified, or if new methods have to be introduced or if some other activities needs to be applied? It would be interesting to focus on the usefulness of quality and reliability enhancing methods, as e.g. failure mode and effects analysis (FMEA), in genuinely proactive work. Are these methods supportive of genuinely proactive work or are they constructed in ways that limit their usefulness to proactive, or even reactive, work? A more in depth study of failures focusing on the application of quality and reliability enhancing methods during the development process would be a way to study this question.

Finally, an area of interest for future research and improvements is the utilization of reliability and robustness methods, especially for the early phases of product development. How to include reliability and robustness aspects in engineering decisions regarding design and selection of concepts, systems and components in a way that feels naturally for the engineers? This is discussed in Clausing and Frey (2005), where they emphasize the importance of using naturalistic, and hence easier to understand, formulations of uncertainty instead of the probabilistic, and more abstract, approach often used in reliability engineering. The idea is to use physical terms that engineers are used to, instead of quantitative terms to describe reliability properties, and then "tune" the design for increased robustness. This can be looked at as being a physical "distance to the failure mode" (Davis, 2006a), e.g. the distance in millimeters thickness of a tire to a worn out state. Clausing and Frey (2005) propose that this

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way of thinking can have advantages especially in early stages of system design, i.e. it can support a genuinely proactive approach.

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Impact of Quality of Service Delivery in Business Education

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Abstract

Purpose – *Quality of Service* (QoS) is a not new word now and it has become more of a necessity than a choice. If organizations want to have competitive edge in the industry they need to introduce quality based practices. With the increasing focus on the quality measures in all sectors; it is also the need of education sector for applying service quality concepts to business education.

Design/Methodology/Approach – In this paper certain quality indicators are identified for the business schools of Pakistan by conducting a comparative study between public and private sector business schools. The purpose of this study is to incorporate quality indicators and measuring QoS delivery, as a result of that business schools may be able to create benchmarks of quality to be used in other schools to sustain quality education.

Findings – Currently in Pakistan, there are few business schools which are providing quality in the limited context of teaching only, and have not been able to effectively focus on *Quality of Service* delivery to the external customers that is students. A preliminary model for Quality of education is designed and later on a comparative study between the public and private business schools of Pakistan is conducted.

Value – There is a lot of emphasis on class quality, that is, *Quality of Education* (QoE) where as process quality is equally important but ignored in *Developing Countries* (DCs) like Pakistan. The paper attempts to create an awareness of having a tradeoff between QoS delivery and QoE by maintaining the impact of QoE as opposed to quality of teaching in determining the overall quality of organization.

Keywords – Business Education, Business Schools, Quality of Service, Quality Indicators

Paper type – Research Paper

Introduction

Service industries are playing an increasingly important role in the economy of developing and emerging nations. In today's world of global competition, rendering quality service is a key for success, and many experts are of the view that the most powerful competitive trend currently shaping business and marketing strategy is service quality. The same need has been identified in universities and specifically business schools are concerned about the *Quality of Education*. The identification of the dimensions which signal quality and the achievement of excellence in business education have emerged this decade as key issues facing the academy. (LeBlanc, Nha Nguyen, 1997.

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Historically it is the businesses schools in developing countries that are showing keen interest in improving the *Quality of Education* but unfortunately they remain unsuccessful due to limited, poor and ambiguous definition of quality in academia.

So far there has been focus on improving teaching methodologies and students learning outcome. Now it has been realized that it is not only the teaching or the students' learning process which needs to be improved, but a combination of multiple processes which need a collective redressal.

Quality of Education is a myth in third world; it is a concept which is least understood, vaguely defined and not properly addressed; and contains a limited portion of overall Quality of Education concept. In order to address this grave misconception and eliminate existing ambiguity the authors have attempted to develop a preliminary model to assess quality from a system's perspective.

The model described in figure 1 explains that QoE is not just related to classroom teaching only but it also has QoS aspect too, classroom teaching is further divided into two sub processes; class delivery process that defines how knowledge is delivered to students and intellectual stimulation process which explains to which extent quality of knowledge is being imparted. QoS is also sub grouped into student support process that defines all those processes that help and facilitate students and grooming process that defines the development of students' personality.
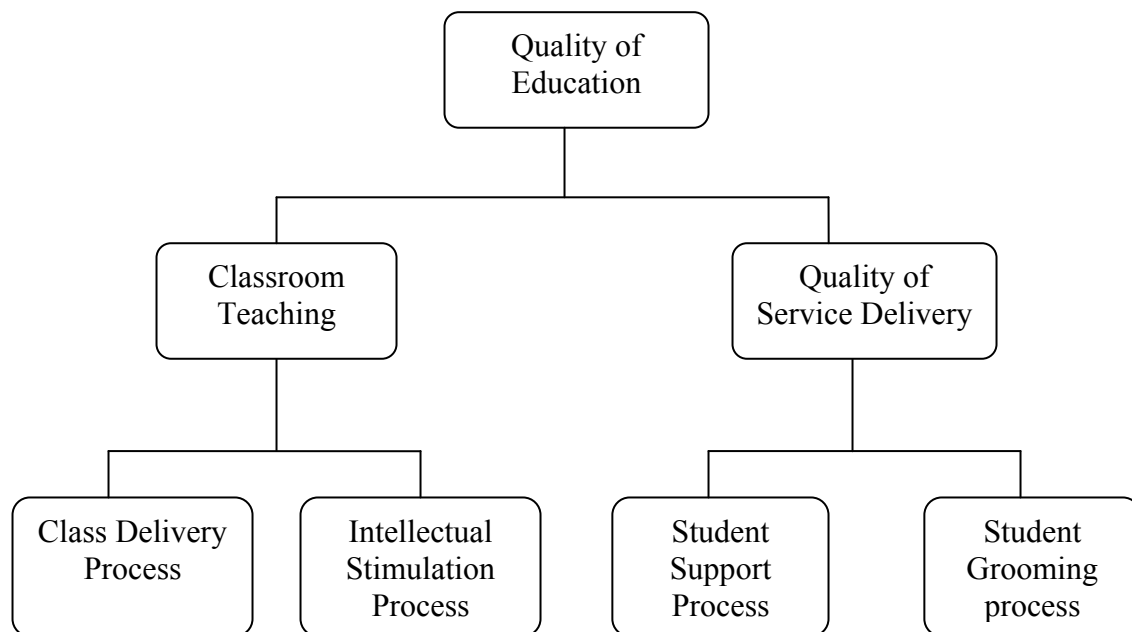
Figure 1: Model for Quality of Education (QoE)

For this, educationists normally encounter the problems of developing measurement indicators and identifying components of quality education. For the purpose of defining quality the authors meant all those step and actions facilitating the students to absorb knowledge in a user friendly way and in a conducive environment.

In seeking to design the instruments to measure quality of education, it is important to appreciate complexities associated with measuring and enhancing quality in higher education; the central role of perceptions and expectations of different type of customer that contribute in the

complexity of evaluating and determining the nature of and resources available to create the educational experience.

Quality – Value Chain

As according to Rowley the QoS as perceived by customers originates by comparison of what they feel that service organizations should offer, that is, from their *expectations* with their *perception* of the performance of organizations providing the services:

Quality = Customer's Perception – Customer's Expectations. (*Rowley, 1997*).

In developing countries the students do not have any perception about quality as per defined model suggest the perception model of student.

No Pressure on Teacher to deliver

No Exposure

No Perceptions

No expectation
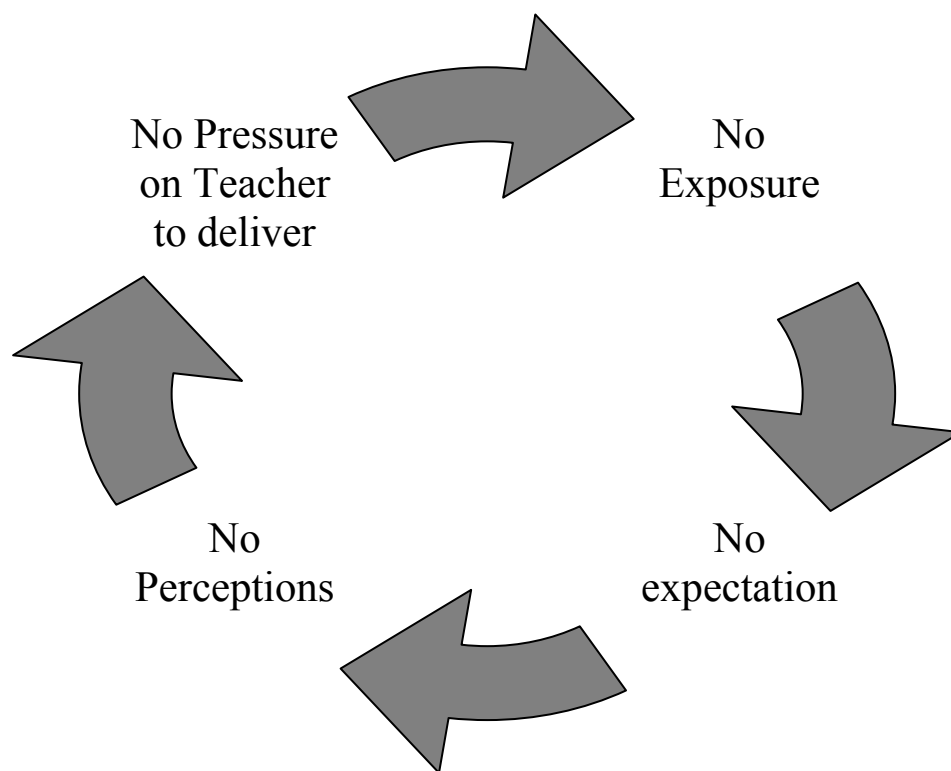
Figure 2: Quality - Value Chain Model

Thus the resultant of the model is that teachers do not have requisite exposure to perform differently and think innovatively.

Literature Review

The lessons of quality management apply to services as well as tangible goods. Awareness also has been increasing that services, like tangible goods, can be guaranteed as a means of implementing a total quality management (TQM) orientation in the organization. While higher education has been exploring some of the tenets of TQM, it has been slow to embrace the power

of service guarantees. The higher education sector in the UK has adopted an outcomes-based approach to the curriculum, assessment, evaluation and quality management that emanated from the behavioral objectives movement in the USA (Mager, 1975; Gosling and Moon, 2001).

Following rapid economic development, the education systems of most countries or areas in the Asia-Pacific region have been expanded quickly. Currently, the people in this region are concerned with not only education quantity but also education quality (Yin Cheong Cheng and Wai Ming Tam, 1997).

Education quality is a rather vague and least defined concept in research and policy discussion in developing countries (DCs), definition may be different to different people, group and nations so it is logical to assume that the indicators used to define education quality would be different. Some may emphasize the quality of inputs to the education systems whereas others emphasize the quality of processes and its outcome. No matter whether referring to input, process, outcome, or all of these, the definition of education quality may often be associated with fitness for use, the satisfaction of the needs of strategic constituencies (For example, policy makers, parents, school management committee, teachers, students, etc.) or conformance to strategic constituencies' requirements and expectations (Yin Cheong Cheng and Wai Ming Tam, 1997). Education quality is a multi-dimensional concept and cannot be easily assessed by only one or few indicators as in DCs.

The design of quality measures for specific service providers should lead to a better understanding of the construct and to the adaptation of quality improvement programmes which correspond to service company needs. From the design perspective, dependable measures of service quality for specific service industries are a viable research strategy to pursue (Brown and Koenig, 1993; Carman, 1990; Cronin and Taylor, 1992; Finn and Lamb, 1991; Zeithaml, 1988). The concern for excellence in business education and the lack of empirical research on the cues that signal quality to students were the bases for this exploratory study on service quality.

Literature review, along with different brainstorming sessions were held that provided the basis for developing questionnaire used in this study, participants of both genders were selected in order to eliminate any biasness. The questionnaire focuses on different aspects and contained 60 service quality variables related to the business school's service offering, such as curriculum, contact personal, physical evidence, reputation, responsiveness, on campus facilities, faculty, students, assessment and grading, fee structure, development planning and discipline. The items were measured on a 5-point, likert-type scale that varied from 1 = strongly disagree to 5 = strongly agree, some questions were on availability of services for hostel and common room facilities for males and females students where 0 = none, 1 = either for male or female students and 2 = for both males and females. Description for the quality indicators is given below

Curriculum – It means that the business school has specialized programs and courses to offer, which are in-line with industry needs, the course contents are updated when required and the curriculum enhances individual capabilities.

Contact personnel – This indicator measures the follow-up and response time of staff, and evaluates if the staff is aware of the policies and procedures.

Physical evidence – It means that if the institution has proper lighting and backup facility for power failure and optimum classroom temperature is maintained according to weather conditions. The class rooms and study rooms are comfortable, premises and guide maps are

available for easier navigation. The parking lot spacious enough to accommodate reasonable number of vehicles, lawns and cafeteria are good enough to meet the needs of students. Also aesthetics and cleanliness of institute is maintained.

Reputation – means that students are satisfied with academic achievement of institution and their institution is affiliated with regulatory authority. The overall degree of the institute has good name in the market.

Responsiveness – determines the availability of instructors and support staff, and their concern towards students learning and growth. The institute gives weight age to student feedback and the students keep on receiving updates on procedural or academic activities.

Access to Facilities – includes auditorium which is spacious enough; an interactive website, proper hostel, transport and lab facilities, common rooms and prayer rooms.

Assessment and Grading – means if the students are satisfied with the grading criteria and find it transparent

Faculty – this indicator talks of faculty individual competence like personality, emotional Intelligence and qualification. It also measures courteousy and friendliness, and professors' communication skills. Also, it includes if the faculty facilitates innovation, arranges lectures by guest speakers and are actively involved in research work.

Student – defines output in terms of student quality, Student teacher ratio, student leadership behavior. The institute provides learning environment to the student, parents are satisfied with institute and workload on student is challenging enough to enhance their individual capabilities.

Fee structure – means that it is at par with kind of facilities provided to the students, and provides merit based and need base scholarships. The students find the fee submission process as simple and flexible.

Development planning – means that the institute focuses on trainings and development for administrative staff has centralized authority.

Discipline – it includes mechanism to resolve conflicts and measures the extent of implementing plagiarism policies, management rules and regulations according to standard operating procedures.

This research paper investigates the impact of the identified indicators on the quality of service delivery in business education and the extent to which these quality indicators are applied in public and private sector business schools of Pakistan. Comparison between public and private sector universities is therefore drawn and its inference is used to get some meaningful inferences. The paper attempts to create an awareness of having a trade-off between QoS delivery and *Quality of Education* by maintaining the impact of quality service as opposed to quality of teaching in determining the overall quality of organization.

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Research Approach

Some quality indicators have been identified by the mutual brain storming sessions and field visits to academic institutions. Quantitative analysis technique is used to analyze the impact of different quality indicators on service delivery in business education. Using these indicators the survey was designed and feedback has been collected and statistical measures are applied on the collected data. The analysis of the results identified the impact of these quality indicators on business education and their application in public and private sector business schools.

Hypothesis of research are.

H$_1$: Private sector business schools are better in delivering quality of service as compared to public sector.

H$_2$: There is a positive correlation between QoS and customer satisfaction in business schools of Pakistan.

In order to justify or nullify the above mention hypotheses focus has been on following two questions

- What is the impact of the identified indicators on the quality of service delivery in business education?

- To what extent these quality indicators are being applied in public and private sector business schools?

For statistical analysis of data MS-Excel, StatPro and SPSS were used on different levels and observations.

Findings and Conclusions

As per the analysis of data performed following are the correlation values on QOS variable.

The correlation values from the table 1 between means of different identified indicators and mean of QoS it can be observed that QoS delivery in Pakistan is strongly affected by faculty factor and the secondly to students(output) where as other factors like responsiveness, reputation and contact personal factors also have a positive impact on the QoS.

Mean Values Comparative Study

Data collected from different public and private sector business institutions were analyzed and mean of each factor is compared table 1 illustrate values of each indicator.

Factor	Public	Private	Correlation b/w QoS
Curriculum	3.553	3.835	0.627
Contact Personnel	3.567	3.705	0.729
Physical Evidence	2.907	3.303	0.687

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Factor	Public	Private	Correlation b/w QoS
Reputation	3.701	3.869	0.727
Responsiveness	3.343	3.815	0.751
On campus facilities	2.397	2.510	0.567
Grading and assessment criteria	3.314	3.711	0.666
Faculty	3.579	3.857	0.792
Students	3.546	3.808	0.777
Fee structure	3.274	3.703	0.633
Development & planning	3.307	3.455	0.628
Discipline	3.268	3.544	0.695

Table 1: Correlation between QoS and Mean Values Comparison of public & private sector business schools

The mean values depict a clear difference between public sector and private sector business schools. Values from table 1 reflect that there is not much difference between public and private sector institution but still private sector business schools are doing a bit better rather than public sector institutions. However, these are not the only indicators which can guarantee quality of service delivery in itself.

Conclusion

The aim and philosophy of identifying quality parameters is not the measurement of quality performance as an end in itself, but the continuing and continual improvement of quality through a process. There has been a trend of increasing competition among business schools and the students explore options globally for business education. Business Schools need to implement quality based practices in their institutions so that they perform well and customers of education, that is, students are being served well too.

Both of the hypotheses have been proved and can be observed from the statistical data that there is limited awareness of the quality indicators in business schools. However, business schools of either of the sector are not performing up to the required standards. So, it is suggested that private sector schools may invest in quality education at higher levels and public sector schools may work on secondary education.

The indicators identified are merely indicative of some of ground realities but may not necessarily depict or reflect the actual ground situation. For that matter a thorough investigation would be required which may entail the cultural aspect of teaching requirements as well. However authors have not discussed the cultural aspects affecting the quality of education and service. This impact of cultural competencies can be measured in further phases of the research. The suggested quality – value model gives the complete picture of QoE in *Developing Countries* and by implementing this mentioned model, the business schools of DCs can compete on international level for QoE and QoS.

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Applications of Organization Development Techniques in Improving the Quality of Education

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Abstract

Purpose:
Organization Development (OD), is still an emerging concept in developing countries. Since universities are the places where the future of the countries is being nourished and developed. Thus if universities of a country are made up to date and fully equipped in terms of trained human resource, other physical facilities, Standing Operating Procedures (SOPs) and Management Information System (MIS) the future of country can easily be predicted as prosperous and emergent. In developing countries education is always given a very less importance specifically in terms of budget allocation e.g. only 2% to 4% of budget is allocated to education in the developing countries.

Revisions of curriculums, increasing the pays of university employees, library improvements, improvement in infrastructures and labs and much more has been done in the name of improving the quality of education for the universities but this had never proved itself to be a remarkable effort as far as the quality of education is concerned. The possible problems in any organization can be at individual level, group level or organizational level which can overall mar the organization. Therefore the main purpose of the research is the design of a model which can help changing the quality of education at university level using OD techniques.

The researchers have designed model by using the techniques of OD including business process reengineering which, in a sense, is also a part of OD, for improving the overall quality of education in public sector universities of Pakistan. The model if implemented with few changes with respect to the culture and environment can not only be applicable in Pakistan but also in all universities of the world.

Method of Study/Approach:
Historical/ Descriptive research method is used for the research.

Value of Paper:
The paper, if implemented, is very useful as it is meant for improving the quality of education at university level. Since it is applicable at all universities of the world (with some alterations) so it is not confined only to the prosperity of a single country rather it

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can help in overall improvement of the world by improving every university existing in it.

Key words:

Organization Development techniques, quality of education, university level, developing countries, improvement model.

Catergorization:

General review

Introduction:

Education which is generally becoming more of a commercial business than a social objective is very critical for an overall development of a country. People are establishing educational institutions for financial gains rather than for improving the education and learning. In short, education has become a business nowadays. However, the functions of the educational institutions are to develop the people physically, mentally, psychologically, socially, and spiritually. (Memon, 2007)

Much of the work is done in the field of improving the quality of education. Tons of papers have been utilized to write literature about improving the quality of education by improving the overall conditions of university environment. But nothing different has ever come up by the research which ever has produced drastic changes for improving the quality of education at large. The researchers here are not at all, by any means, saying that all the work ever done in this field is a wastage but are trying to emphasize the fact that all efforts done before were not long lasting. They deteriorated with time and/or with change of the personnel in implementing body.

The researchers have taken Organization Development (OD) as a focal point for improving the quality of education, since "the quality of an organization's human resources is key to success, and much of it is a function of training and development", (Epie, 2001). And OD is improving the output by means of improving at individual, team and organizaion level taking human resource has the means for achieving the target.

About OD:

There are multiple definitions of OD. Richard Beckhard defines organization development as an effort (1) planned, (2) organization-wide), (3) managed from the top, (4) to increase organization effectiveness and health, through (5) planned interventions in the organizations processes using behavioral science knowledge". (Beckhard, 1969). Similarly OD is also defined as a systematic process for applying behavioral science principles and practices in organizations to increase individual and organizational effectiveness (French, 2008).

So OD is improvement of the organization by developing its human resource through planned change efforts/interventions at all levels using human behavior approach. The

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researchers in their research have made a model to improve the quality of education at university level by following the foot steps of OD. Since, an educated and skilled workforce is essential for the effective functioning of the economy, the competitiveness and wealth of the nation, as well as for the overall well-being of society (Beardwell, 1997). So the researchers have viewed the whole workforce of a university under a microscope by dividing them in two categories for the planned change. One of the categories is related to education members and the other is administration. The education members include all the personnel of a university related to education they include students, teaching assistants, lecturers to Rector/Dean and administration includes all levels of working staff from janitors, supervisors, library/lab staff, and student's affairs' personnel to Rector/Chief Administrator. However, the model presented, applies equally to both parts as independent entities and as a single entity.

Since OD takes up human development as a core issue for improving an organization so our improvement model will device a model for improving the human capital for improving the quality of education at university level.

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Human Capital at a University:

Since universities in any country is operated by following members of the society

1. Private (Organizations including Trusts, People etc)
2. Public (Government)
3. Both (Semi-government)

Every one having different departmental categorization. However, all the universities can mainly be categorized in three departments catering the human capital which are

1. Faculty Members
2. Administration
3. Students

Faculty members are pivotal in improving the quality of education as they are the dissimenator of the education however, administration is also a key factors without its participation the overall objective of quality of education can not be met. Students are the key stakeholders.

Getting Ready for OD:
Change is always considered something that will lead to downsizing, cutting of pays etc, thus it is never welcomed. At the same time change is very important since in today's business environment more than at any time in history, the only constant is change (Brown, 2006). The organizations which do not change consequently are banished so an organization must develop an adaptive orientation and management style that is geared to its environment (Brown, 2006).

A team comprising of early middle career professionals from educational members and administration be made. In the start the be given an insight about OD through extensive training. Consequently the team members will come to know about the need, importance and type of change required in their departments back in their offices.

After the training they should start talking about OD and the change which should be there without harming the sanctity, importance of any other office bearer. This activity will slowly and steadily incorporate in the minds of the educational members and administration about the positive change which is coming.

This activity will get the educational as well as administration members ready intuitively about the change that should come (or is coming) to overall improve their own organization, in this case university.

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The Confrontation Meeting 1:
The confrontation meeting is a one-day meeting of the entire management of an organization in which they take reading of their own organization health (Beckhard, 1967).

After continuous slow poisoning about the positive change by the team, the rest of the professionals should be almost ready for the change program and the call for the change program will not come as a surprise for them which otherwise would be a great deal.

After the confrontation meeting which is attended by almost all the professionals of the university, the team would have had gathered a data regarding the problems and concerns about the change (OD) program, prioritized the problems and a well laid action plan for improvement.

At this point the OD team has gathered the data regarding the main problems faced by the members of the university.

The data gathered from the confrontation meeting would be about the collective/faced-by-many problems. The need is required that every one is interviewed so that data regarding problems at individual level must also be gathered.

Confrontation Meeting 2:
Confrontation meeting 2 will not be like the usual confrontation meetings as described by Beckhard, 2001. It will be a real confrontation type of meeting in which all the workforce confront with their issues in a true sence.

Confrontation meeting 2 comes within the first week of the first confrontation meeting. During confrontation meeting 2, when all the members of the organization are known about the latest development in the organization and its intention and they have no doubt about the positive change, its time to confront in true sence.

All the problems at individual level, team level and at organization level should be addressed and noted down. Confrontation meeting 2 is a sort of meeting in which all the employees come up with their grudges, problems that they think they have with others, all the things that they feel are not their, including pays, benefits, hygience factors issues, interpersonal issues – every things that is a hinderance in their performance.

Atleast two sessions are required for the such a meeting because the problems will be so many that it may take multiple days listening and understanding the causes and gravity of the problems.

The outcomes of this meeting are very important. The outcomes will tell the higher ups whether the current scenerio of the organization is alligned with the vision, mission and objectives of the overall orgnaization. The meeting will also provide an opportunity to the top management to see what are the ground realities in a clearer manner. It will set the mind of the higher ups about the change which is required in the organization. The

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second meeting will also show seriousness of the management towards change – positve one. The meeting will also get ready the employees for major and drastic changes which will overall pump energy and enthusiasm in the whole orgnaization.

At this level most of the problems would still be unidentified specifically by the younger staff and faculty members. This problem can be mitigated by individual and team interviews.

Individual and Team Interviews:
The OD team should interview each and every individual and team of the university who either fall in educational-member category or administration category or both.

Individual of each category will have different problems pertaining to nature, attitude and qualitifactoin, etc. Some of the responces of such interviews would likely to be as listed below.

From Education Group:

1. No time for further studies.
2. No time for research
3. Too muck extra work load.
4. Problems in class
5. Non availability of lower staff
6. etc

From Administration Group:

1. Students need to be disciplined.
2. Faculty must be given lessers powers than what they enjoy now.
3. Lesser pay than faculty
4. etc

Common problems to both groups:

1. Compensation in terms of pay.
2. Problem of no-recognition.
3. Too much distance between administration and faculty.
4. Discriminatory Problems
5. Problems with colleagues and/or students.
6. No or less fringe benefits.
7. Too much management levels
8. Bureaucratic Culture
9. Lack of Co Curricular Activities
10. etc

OD Solution to All the Problems mentioned above are given as follows

Career & Life Planning:
Career life planning is the process of choosing occupational, organizational, and career paths. There are several different approaches to career life planning. All of them use the idea of goal setting and achievement motivation to gain greater control over one's future career development.

Career and Life Planning is a very important aspect for every individual of an organization. Career, as mentioned by Hughes, consists, objectively, of a series of status and clearly defined offices . . . subjectively, a career is the moving perspective in which the person sees his [sic] life as a whole and interprets the meaning of his various attributes, actions and things which happen to him (Hughes, 1937).

In the university scenario the OD team will meet with every employee of the organization to device ways with the concern employees to help improve and develop their careers. Special initiatives like compensation, leave, low burden, etc must be taken to help improve their education.

Career planning can provide employees with information that will enable them to make better career decisions (Brown, 2006). Consequently the employees will be then made part of the project teams which will be in line with their defined careers and life plans. This will make them satisfied and enthusiastics about the projects.

Empowerment:
Empowerment is the process of giving employees the power to make decisions about their work (Brown, 2006) and it is an act of leadership (Townsend & Gebhardt, 2006). As a university is an amalgam of people with different and multiple expertise and interests therefore, by empowering the employees of a university their would be no limit to what good can happen to the quality of education in particular and to the university in general. Mostly people think that empowerment can cause serious problems, however, by having responsibility of all the actions can keep the problem issue low as described by Townsend and Gebhardt in2006, according to them, responsibility is the obligation to act; authority is the power to act; and accountability is the measuring and reporting the act and accepting the consequences. When authority and responsibility match, accountability is unambiguous, and you have empowerment.

Empowerment is a very important tool as employees who are empowered are more proactive and self-sufficient in helping their organizations to achieve their goals (Brown, 2006). Similarly if the employees of the university are empowered they will do their job in a better, expected and desired manner which will cause improvement not in their day to day matters pertaining to university but also quality of education.

Wellness Programs (Brown, 2006):

Wellness programs means to improve the overall state of health of an individual. This include provision of sports complex, availability of doctors, psychiatrist, psychologist etc to improve it. Many companies are already spending a lot on wellness programs e.g Xerox, has $3.5 million fitness and recreation center in its Virginia training facility, and General Foods has health and fitness efforts for 50,000 employees in 30 locations (Brown, 2006). Similarly a university should create wellness programs. Every member of the organization be allowed to be the part of it and must be trained and must be motivated to improve the their health, day to day activities, personal life (by Emotional Intelligence programs, psychology etc), phsycial fitness exercices etc.

Improvement of Hygiene Factors & Motivators:

Hygiene factors are the factors seeming to make individuals feel dissatisfied with their jobs and motivators are the factors seeming to make individuals feel satisfied with their jobs (Bartol et al, 2003). This is one of the main reasons of turnover in an organization.

The hygiene factors and motivators must be identified with the help of the OD team during the individual meeting with the workforce. Consequently the hygiene factors and motivators must be improved. In this way overall improvement and less turnover can be guaranteed as according to Herzberg's two-factor theory according to which hygiene factors keep workers from feeling dissatisfied, but motivators help workers feel satisfied and motivated (Bartol et al, 2003).

Family Culture:

Family culture is the one that lacks the most in most of the organizations. In high context cultures people respect each other not because what the people are capable off, but because of age, designation etc. The workers come to their organization, do their part of the job and leave. In order to make an organization competitive and growing people need to think about their organization beyond their selves. The workforce must think of the organization as their home and the people working in their organization as their family members in order to be competitive and growing. This can be achieved if a person is empowered, the person's future is secured with the organization (Career and Life Planning), recognition, wellness programs etc. By incorporating the family culture, synergy is guaranteed which can be used to achieve the vision, mission, goals and objectives of the university.

Recognition:

Recognition is very important as it motivates and encourages the workforce to work with more enthusiasm "even when people know something is right and best thing to do, they still need encouragement, examples, and rewards to maintain a desired behavior (Townsend and Gebhardt, 2006). Absence of recognition can cause serious damage to not only the workforce but also the overall process the workforce or individual is involved with. All the workforce must be recognized accordingly may be alone in the office, in meeting, during important events like convocation and gathering, notice boards etc.

Recognition brings good input from all the workforce. According to Townsend and Gebhardt, 2006, if the employee hear thank you the odds are good that they will continue to help the company improve. Similarly to improve performance by considerable amount on and off workforce should be regarded. But the regard and recognition should not become so frequent and at-surface-only that the workers think of it as something un-genuine. Every recognition program must be prevented from becoming seen as an entitlement, something that is expected no matter what the contribution or effort on the part of the recipient (Townsend and Gebhardt, 2006).

Recognition also stops/lessens the turnover. Even a sentence of appreciation can have drastic effects. People who feel appreciated stay longer at an organization and work harder while they are there (Townsend and Gebhardt, 2006). Recognizing good efforts and inputs of the employees will produce Nobel-laureates and this recognition will drill down to students as well in the form of improved quality of education and recognition by itself. Who, in return will do wonders.

Participation/Role in Administrative Activities:
Though every members of an organization is doing some aspect of administrative activities they must also be made realized of the importance of their part of work. Though this is not the main task of faculty members but faculty and other staff members should be given administrative roles. It brings ownership. With ownership the need to workhard and devotedly is guarenteed which in case of a university causes improvement in overall quality of education.

Training and Development:
Trainings and workshops must be a regular part of organization.

Training, as defined by Manpower Services Commission in 1981, is a planned process to modify attitude, knowledge or skill behavior through learning experience to achieve effective performance in an activity or range of activities. Its purpose, in the work situation, is to develop the abilities of the individual and to satisfy the current and future needs of the organization. The training and workshops should be on improvement and development of skills like interpersonal, leadership and management, decision making, stress management, emotional intelligence (EI), time management, teaching methodologies, conflict resolution, people management and most importantly OD as a whole. The question that who will attend which workshop will however depend on the critical importance of a person and similarity of the workshop and the problem.

The workforce must be told about the importance of their part of the whole process in overall achieving the goals of the organization and about the training program as a tool or source in improvement of the organizational goal through improved skills of the workforce. As this will substantially decrease the negative effect of training which, according to (Rainbird and Maguire, 1993) is … much of the training reported was for organizational rather than individual development, suggesting that many employees would not regard the training they receive as training at all, since it neither imparts transferable skills nor contributes to personal and educational development.

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This in turn will improve the productivity which means quality of education at a univeristy.

Problems at Team Level:
Up till this point the total workforce of university have gone through the OD training as mentioned above, this will cause a great amount of decrease in problems at team level. The possible problems that can arise at team level are

    i.   Operating Problems (Brown, 2006).
   ii.   Defining and Clarifying Goals Problems (Brown, 2006).
  iii.   Interpersonal Differences, Conflicts, Misunderstanding (Brown, 2006).
  iv.   Antisocial and Dysfunctional Teams Norms Problems (Brown, 2006).
   v.   Decision Making Problems (Brown, 2006).
  vi.   Cohesiveness and Groupthink Problem (Brown, 2006).
 vii.   Diversity
viii.   Interpersonal Problems

Proposed OD Solution:
Since at this stage all the members of a university have received OD training, solving the problems at this level will be easier than that of any time before. All the workforce is aware of the interpersonal skills, have gone through the confrontation meeting, are now part of a family culture, have well defined goals and objectives, have their career and life planned and have been made part of the teams with respect to their planned careers and redefined objectives, are now more empowered than before, are enjoying good health through wellness programs and having better hygiene factors.

Organization Level Problems:
The main problems left with the university after it has gone through the above mentioned phases are

    i.   Processes Problems
   ii.   Quality Problems
  iii.   Behavior Problems

According to Jacka and Keller, 2002, the classis definition of process is that it is a mixture of inputs, actions and outputs. And the accumulation of activities that takes place in each business process is what ultimately determines whether a business can meet its objectives (Jacka and Keller, 2002). Processes Problems are those problems that are related to lengthy processes, delays, unnecessary approvals, cycle time, idle time, useless processes (any process must add value (Jacka, J. M. and Keller, P.J., 2002) etc. They make the processes that long that no one bothers to initiate such processes. Sometimes they are initiated only in dire needs. Such processes also seize creativity and innovation. This is one of the major problems at organization level that most of the jobs are never initiated because of the length of time they will take to complete. Only those organization can achieve world class performance that continuously do business processes improvements/benchmarking/reengineering. Tenner and DeToro, 2000 has also

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emphasized the same fact. According to them, a culture conducive to achieve world-class excellence is one with a process oriented management team. Similarly business process reengineering is required for improving the overall performance of a university. For continuous improvement the university must do process improvements on regular basis and whenever the need be.

Quality problems and Behavior problems will automatically be swept away as the all the university staff including the faculty has already gone through training and development phase. By this all other organization level problems e.g finance, building etc will be automatically be poured through better admissions, seminars, trainings etc, in once the improvement in quality of education is attained, which according to authors is attained by the OD model presented.

Proposed OD Model for Improvement of Education at University Level:
Chart 1, is the proposed OD model for improvement of education at university level and ellaboration of each step is given as above.
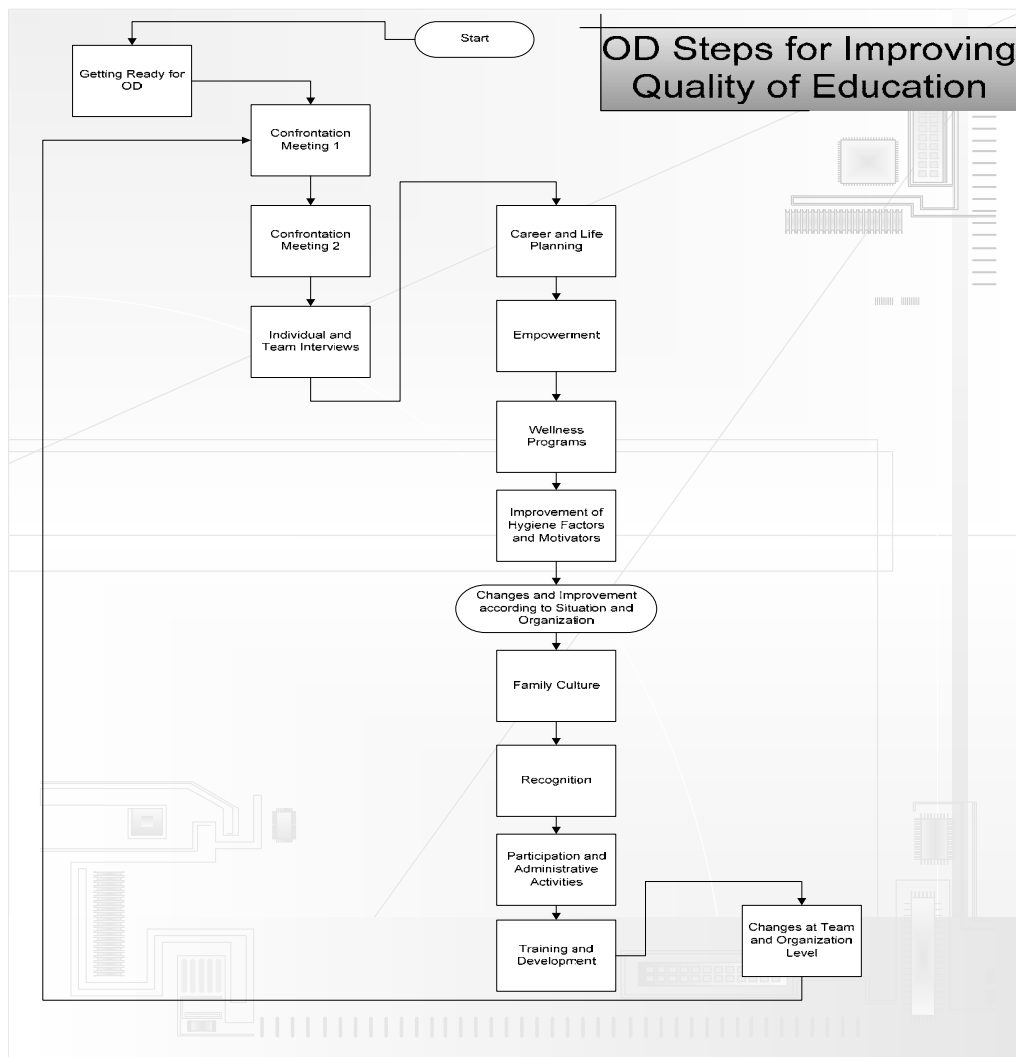
Chart (1)

Conclusion:
In this way when all the staff of an organization are satisfied as an individual, team and organization, they will serve their customers – in this scenerio the students and the country and the globe at large, in a better manner. OD will cause synergy, improve in processes, quality and better behaviour will ultimately be met. It is because of the fact that almost all the possible problems that can occur in any organization are mitigated by the OD model presented. The model presented is useable in any organization with some alteration for improvement. The model can also be used to overcome a specific problem e.g if in any organization turnover is the problem, the model can be used, similarly for improvement in processes the very model can be used and nonetheless it can also be used for quality problem either in service industry or manufacturing industry.

Room is there for further research e.g application of the model in organizations other than education can be made.

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Quality Assessment of Academic Initiatives
for Higher Education Research in Pakistan

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1. Abstract

Higher education sector is facilitating higher learning institutions for the socio-economic development in country. Number of program and initiatives has been taken for improvement of higher learning viz. strengthen IT infrastructure, faculty development, improving access and leaning, excellence in research, good governance & management, quality assurance in standards, assessment & accreditation etc.

The university-industry interaction provides quality enhancement to two entities. higher education sector, in which research through practical approaches is being groomed and Industries in which quality dimension is in existence will likely to result its end products to compete in era of globalization.

The overall study will focus to define and assess the quality dimensions with various policies being practiced at higher education sector for overall quality of research at higher educational level with a view to fill the gap between industry and academia.

Purpose - The purpose of the study is to assess the integration of existing research being undertaken at Pakistan for socio-economic growth of country. In the context the study intends to identify and suggest various policies, procedure and some sort of standards to work as bridge element between academia and industries. The study will also explore how HEC can provide facilities to universities to fulfill initial requirement of industrial sector and at the same time monitor the facilities using some effective mechanism.

Methodology - The paper will analyses the current initiatives of higher education sector related to industry academia relation and propose the selected quality indicators for use in management audit of respective programs.

Findings -The study will assess how higher education sector intervening help to improve quality of Education in Pakistan. It will also review its role to strengthen industry academia relation by playing the key role in the economic development of Pakistan

Value of Paper - Publications of this paper will help policy maker/higher education sector to design/upgrade/modify the existing initiatives being undertaken in developing nations.

Keywords - research & development, carrier appraisal, collaboration, assessment & evaluation, scientific solution, area of study.

Paper Type – case study

2. Background

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Quality in education, training and lifelong learning is required to compete globally. Steps in Pakistan for promotion of quality education and initiatives are being taken right away. These initiatives have certainly starts focusing all aspects of quality enhancement in education, learning and training. Through technological development and infrastructure quality objectives are easy to achieve. Moreover quality assurance and enhancement are essential components (Brookes and Downie, 2002) of quality which also helps organizations to achieve effective quality goals. For planning, quality objectives are necessary to be established which may develop new process, standards and procedures within organizations and academia.

It is important to discuss what resources are required for enhancing quality of research in our academia. Quality in education comes together with performance of teaching, learning, academic programs, research facilities, staff, students, infrastructure etc. In addition students getting admission in Master, Mphill and PhD programs are the outcome of academia through which they compete at national & international forums and provide possible solutions to industry, SME(s), agriculture, livestock etc. Though it is much debatable that how and at what level research produces in our country can fulfill national requirement for socio-economic development.

Quality in knowledge based economy boosts industry performance, as the quality of research in our academia can be utilized to improve quality in productions/outcomes of our industries as well as services sector. In the recent past, initiatives for the improvement of quality in research has been taken by the higher education sector for promoting research & development (R&D) culture within academia, however more initiatives are to be taken for quality assurance by defining assessment & evaluation criteria for educational programs so that better outcome of research could be achieved and same research may be utilized in industries and SME(s).

Despite the abundance of research, there is no universal consensus on how best to measure quality in higher education (Becket and Brookes, 2005). Even in our country quality assessment in higher education sector may vary across different areas. So for the quality assurance, initially suitable policies are needed to be set out for easy access of higher education and collaboration with private/ commercial entities.

It is also considered that assessment or evaluation in higher education sector provide the better outcome of quality. This assessment and evaluation may fulfill this gap but without the vision, goals, good governance, technology infrastructure, research & development facilities etc. quality parameters even does not exits. No doubt the assessment and evaluation for quality in education is vital which is based on development and interaction of all entities in academia.

The authors has assessed important initiatives have taken by higher education sector for improvement of quality in education. Also focus quality dimensions being practiced at national & international levels and requirement of overall quality of research at higher education within country with a view to fill the gap between industry and academia.

3. Introduction

Higher education sector has taken initiatives for improvement of quality in higher education in the Pakistan. Though to create the environment of research within the campuses there are requirements for improvement of facilities to researchers, faculty members and students. Also internal academic assessment and carrier appraisal system are essential to encourage researchers to keep the pace for developing latest research ideas.

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Overall strategic initiatives for increasing the numbers in business and industries are taken within country. In addition the involvement of academia for entail research and scientific solution may certainly put innovations in the industry, SME(s), agriculture, livestock etc sector.

In Europe (European Commission, 2006) working groups are dedicated for joint research programs between academia and industries. These groups have put coherent and powerful set of recommendations.

In our country there is currently required to turn research outcome into globally competitive era. To achieve this, programs like long term relationships, strengthen cooperation, research management support are essential to introduce. Partnerships between university industries are to be established locally and internationally for jointly research support.

4. Challenges

Recently some of challenges ahead on our country economics, this required high level strategy with set of policies and procedures to strengthen overall economic condition of country. These challenges are also effecting to define role of nation globally.

4.1 Competition

Increasing global competition has already starts new innovations in quality around the world. Having the huge competitors available from neighbor countries particularly China, India, etc. Pakistan will have to recognize its own social identity. Further there is need to address issues in the light of new environment of globalization, technological change and aging population.

4.2 Knowledge Based Economy

Driven from knowledge based economy to knowledge based society has social, economic, political and technological dimensioned which are required to be focused.

4.3 Governance Model

Role of leadership is out of sight and empowering the organizations is lacking behind. Due to this reason many opportunities are missed and could not be fruitful. In the developed nations organization are empowered with set rules and decision which are implemented and regular improved in the favor of increasing quality.

4.4 International Interference

International interference effects implementing policies, wherever modify policies are implemented without ground realities which effect overall economy of country.

5. Gap Analysis

Policies are required for easy access and participation to education and research. This includes learning objectives, teaching practices, distance learning programs etc. The role model within academia for better decision making may develop possible access of education and research. These role models also utilize for awareness so that enrollment in higher education sector could be increased. As per the statistics (World Bank, 2006) only one-fifth of students could enroll in the universities of Pakistan (statistics of year 2004), who passed

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the intermediate (HSc) exams. Where as remaining enrolled in professional affiliated colleges or enter into labor market. The awareness and easy set of policies e.g. distance learning, low fees, stipends, scholarships funds in education may increase overall enrollment.

Secondly in the enrollment of students for higher education there is larger gap available in enrollment between general and engineering, agriculture & medical field of studies. This unappealing situation may be due to very small number of seats available and secondly awareness, motivation and career guidelines. As per available information of 2005 in Pakistan, only 5.2% students in agriculture, 13.2% students in engineering and 2.7% students in medical enrolled, where as 47.3% enrollment in general area of studies.

This large gap is need to be reduced on priority as the globalization is going very speedy adopting computing and technology solutions for education, industry, agriculture, medical, livestock, constructions, communication etc.
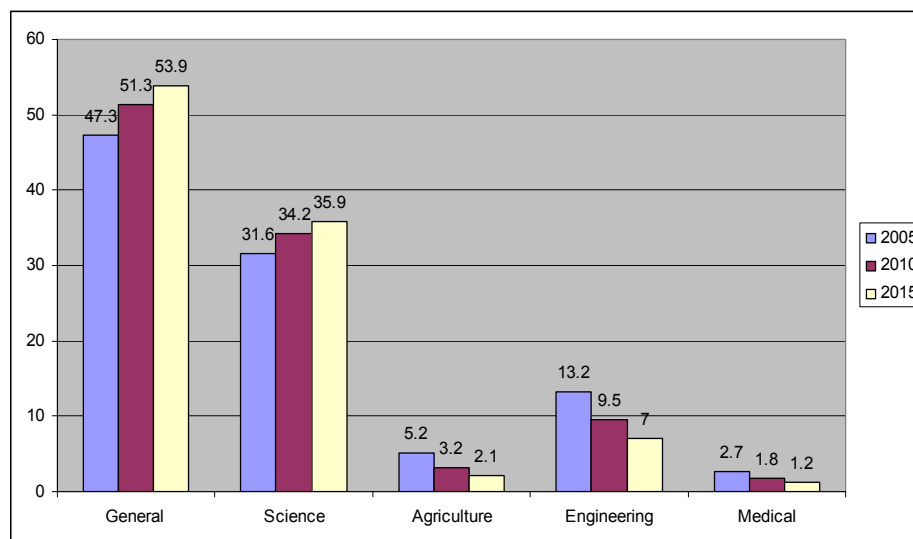
Figure 1: Projected Distribution of University Enrollments by Discipline

As per the statistics available (Pakistan Research Repository) more than 3000 of PhD(s) have been produced within the universities of Pakistan. In the figure 2 the gap between numbers of research produced discipline wise in the universities of Pakistan again visible. Ph.D(s) produced in engineering technology, medical sciences, agriculture is even not equal to the number of social science.

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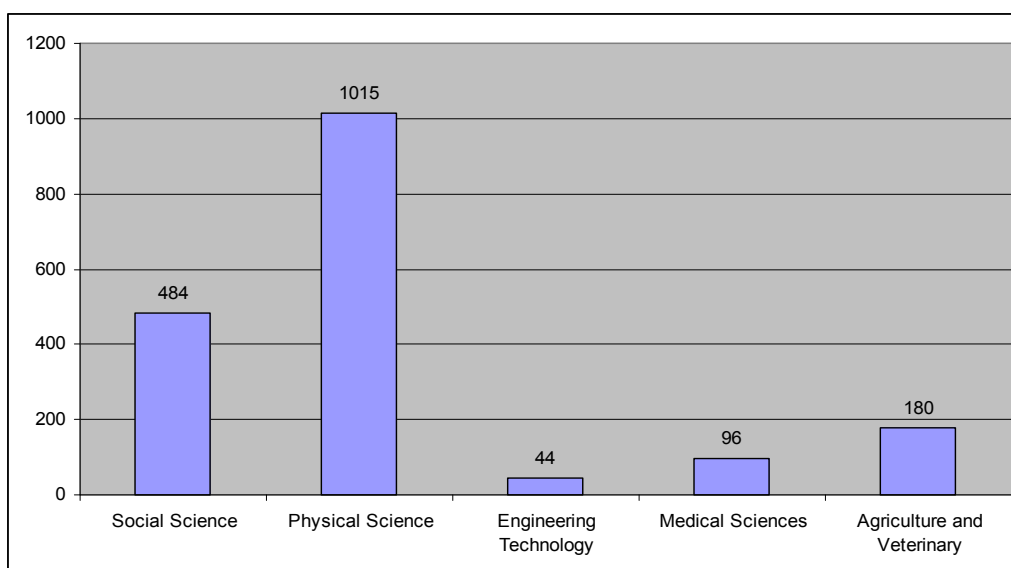
Figure 2: Discipline wise Ph.D(s) produced in the universities of Pakistan
Sources: Pakistan Research Repository 28th May 2008

In the case to set the strategic goals and to achieve knowledge based economy, modern engineering tools and effective agriculture procedures are required. For the support of Industry, SME(s) and agriculture sector currently these disciplines required highly consideration. Not only the numbers of seats are required to be increased for these field of studies but the over all quality improvement of education through technological infrastructure, equipment etc. is to be upgraded/modified. Furthermore easy procedures and methods of study with better research facilities may also increase the participation.

6. Driven to knowledge based economy to knowledge based society

The transition carries many dimensions and process where quality of education and training, latest technologies and trends, competencies and skills, quality consciousness, digital knowledge, awareness etc are major indicators to be focused.

As per the composite indicators for knowledge based economy (European Commission, 2003) percentage of investment in higher education sector is measured which based for total input of quality enhancement. As per details available estimated Rs. 390 Billion will be used for quality enhancement in higher education sector. The 25% of amount will be utilize for research & development activities, 35% equipment and infrastructure as fixed capita for providing quality of research, 26% will be utilized for faculty development and higher research funding. As research support program are also important so 5% of funds are allocated for it. Trainings for academia and its employees (capacity building) are given the edge of 9% allocation. E-Governement is also given less then 1% of allocation.

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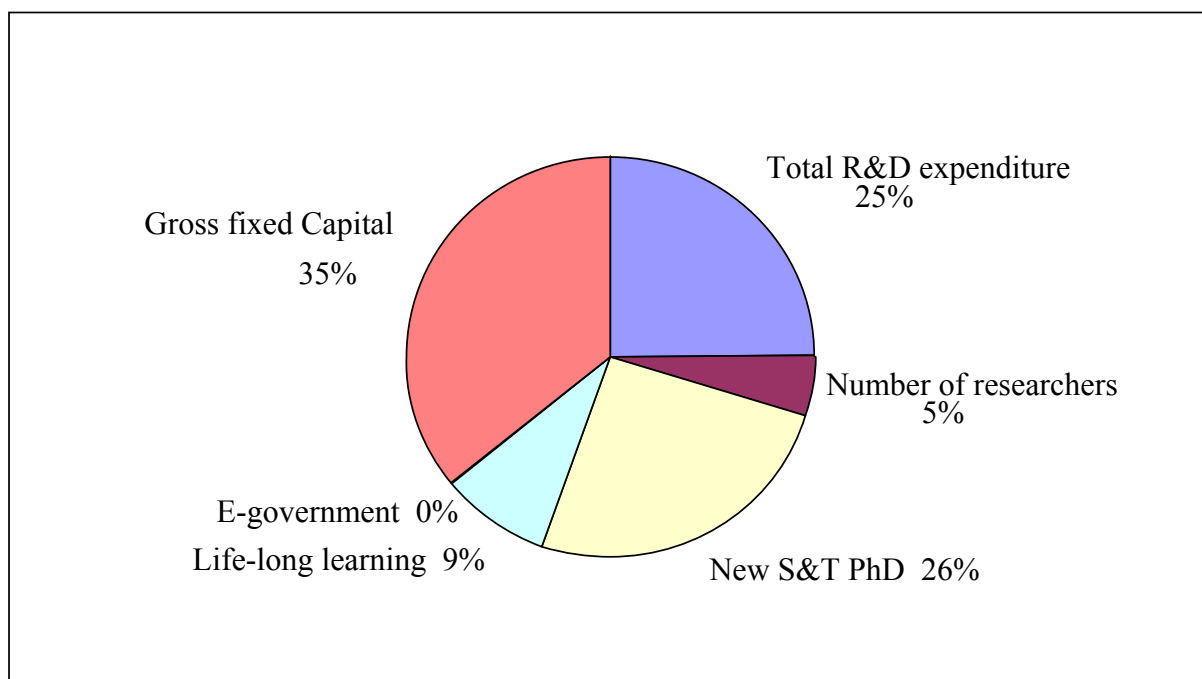
Figure 3: Total Input for knowledge-based economy in Higher Education Sector (2005-2015)

7. International Trends and Initiatives

Diversify the funding resources is one the major initiative. This is previously observed that changing of political order in our country raise new priorities which sometime effect the progress of previously initiatives. In the USA, system is highly decentralized and even public sector universities diverse funding resources including funds from state and national government, foundations, corporations support tuitions fees, alumni gifts etc. where as private universities gets endowment funds.

Internationally academia seeking diversity for funds raising despite relay on pure government resources. Strategic initiatives are developed in our academia for maintaining the quality of education through many resources other then government funds. As targeted goals are difficult to meet once the political government priority or initiatives are changed. So resource generation from other places may help academia for continue initiatives.

One of the important resource generation idea through academia-industry strategic partnerships in which academia may generate some resources providing human development training or vice versa and similar providing industries possible scientific solutions. Similar in agriculture and livestock number of procedure and methods are required where the consultancy is helpful for farmers.

8. Quality Indicators

Authors have reviewed and prepare quality indicators (European Commission, 2002 and Sajid, 2003) with recommendations based on increasing overall quality of research in academia as well as helpful for establishing partnerships with industries. National and international interests and trends are also reviewed which are essential to increase the quality of overall research in academia focusing the same research could be utilized for socio-economic growth of country.

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8.1 Latest Curriculum

One of the major initiatives required to be taken for introducing latest curriculum in academia. This would only be possible if international syllabus, geographical position, priorities etc also made in agenda during the curriculum development. Latest curriculum can bring awareness over latest technologies and tools in our academia.

8.2 Research Tools

It is observed that due shortage of research tools and material, the research produced in our country based on only theoretical concepts. Due to this factor research conducted locally difficult to compete in international era. The policy makers of higher education sector should allocate adequate budget for researchers so that testbeds or computing simulations be developed within in academia.

8.3 IT Infrastructure

Information Technology is one of the most transformative in emergence of new learning objectives. It has certainly changed the ways of access and learning. IT infrastructure is currently the need of any organization for running its internal and external business processes. As the major business process are being taken care under information technology tools and computing software. Academia is required to be equipped with latest IT equipment so that effective communications between universities could be possible. As well as software based methodologies and simulations could be develop, test and run on such machines.

8.4 E-Learning

Currently IT facilities can play the role in success of any organization which provides ease of management and learning methods. It is now very important to train the employees and academia for IT facilities. E-learning is also use for capacity development of academia. This is much needed as many of research materials and e-libraries are now available through internet and digital format.

8.5 Technology Awareness

It is one of disadvantage that research produced in our academia could not recognize or compete internationally by not adopting latest technology and trends, which is probably lack of technology awareness. In this regard academia should arrange the seminars and workshops of technology awareness with collaboration of international academia & industry for not only faculty members & researchers but also for students.

8.6 Faculty Development

Quality of teaching is linked with effective & efficient teaching practices and knowledge. Programs are essential to allocate fund for faculty development. Currently higher education sector in Pakistan has taken initiatives for providing foreign and local PhD scholarships. In addition these programs and academia also needs quality enhancement and assessment so that students enrolled in local universities produce authenticated and quality of research.

8.7 Innovations towards Industry requirement

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This has been an issue that a very small quantity of research projects developed in academia are being used in industry of SME(s) in our country. The researcher are required to follow the latest trends as well the requirement of industry so that research produced in our academia could be utilized in better industry productions and also to compete in international markets.

8.8 Trainings

In context of IT trainings, skillful capacity development is also necessary in academia. Enhancing researcher's technical, communication, presentation, scientific etc. skills will helpful to broad vision. Entrepreneurship trainings are also helpful to researchers to exploit their knowledge and develop potential commercial linkages.

8.9 Relationship with industry

Currently there is need to built the relationship of academia and industry. Higher educations sector should allocate the funds for seminars and workshops of university academia interaction so that relationship could be develop and requirement could be visualized. Moreover new such programs are also required to be launch to closer the gap between academia and industry.

8.10   Partnerships with related Societies

Universities in Europe have developed their partnerships with industries and similar association within the Europe and all over the world. In our country there is requirement to develop relationship with such associations so that it may be examined that how business community and academia could work in partnerships to meet research and development (R&D) needs.

8.11   Industry based Seminars

This is also important that industry based seminars be arranged for awareness. In our country academia must be aware that what are the industry requirements and how these be met with through available resources.

8.12   Areas of Interest

It important to know the factors and problems required to meet market needs. This is based on the relationship to be developed between industry and academia to generate the requirement with possible scientific solution. This would effect on overall quality of education and industry productions.

8.13   Exchange of Information from neighboring countries

Exchange of information from neighboring countries will benefits researchers to resolve the industry related issues with technology solution. Particularly our neighboring countries like Chain and India have already initiated their programs of collaborations with related societies and academia industry interaction programs.

It would also attract if the programs like staff exchanges or positions in industry of researchers with financial incentives are created locally as well as with our neighboring countries.

8.14 Paid Internships of Student to Industries

Education sector is required to finance the students and researchers for paid internships/stipends at industry and SME(s). The requirement of internships should be communicated to academia so that related placement is made. Secondly this would certainly generate the actual requirement of industry for their possible solution.

8.15 SME(s) Support

Higher education sector can provide guidelines to SME(s) for scientific possible solution. The regional offices can promote collaborations between SME(s) and higher education institutions & research centers to develop professional networks. This would certainly help to indentify the basic needs and technical requirement required to SME(s) established all over the country.

8.16 Good Governance

For any success of organizations good governance plays a vital role. Authorities are responsible for making the procedures inline with the requirement of employees. In our educational institutions authorities are required to be provided administrative autonomy to manage inter academic issues with defined and agreed set of policies.

8.17 Administrative Autonomy

Autonomy will be required at institutions level like recruitment of staff, financing, etc. Moreover national legislation should allow researchers of academia to work part time and consulting vice versa in research related projects.

8.18 Research Management Programs

Research Management support programs are required to initiate and manage. These programs must focusing not only industry academia but also overall research of academia abreast with latest technological trends and requirement. These programs must be assessed with appropriate set of rules for quality enhancement.

8.19 Working Groups

Taskforces are required to be constituted in the form of working groups. These groups should look forward not only for managing the academia industry awareness but also responsible for quality of life long learning , carrier appraisals, administrative barriers, structure initiatives, knowledge & skills etc. and particular the research of academia to use as socio-economic development of country. Further working groups also identify the requirement of industries, SME(s).

8.20 Access and Participation

Free or easy access to resources eventually increases the participants of researchers. The academia in our country required to define easy access policies to utilize resources available. In this case partnerships are also required to develop conducting instrumental or other skill development related trainings for research at national and international levels.

9. Conclusion with recommendations

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Quality assurance and enhancement in education can raise quality in research, learning, teaching, analysis, procedures, mechanisms and system. This also guarantees the improvement of overall standards and quality in higher education. The study guides how quality enhancement can be achieved through the interaction and collaboration of two entities i.e. academia & industry. The recommendations are certainly helpful for higher education sector to enhance students and researchers learning activities by incorporating latest technology tools and trends particularly those programs which are not yet initiated. Highly considerations of policy maker of higher education sector are required to gear up awareness over areas of study e.g. medical, engineering & technology, agriculture etc. Potential research of these areas can enhance and improve the quality and the outcome in the shape of strengthens economy. The focus on area of studies can certainly help policy maker of higher education sector to meet the challenges ahead on the economy of Pakistan. The assessment and evaluation criteria of higher education sector are much required to be revised. Further the idea of learning and teaching as research should involve deliberate and systematic methods which may be utilize to develop and implement teaching practices with advance learning experiences.

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SELF-ASSESSMENT AS A TOOL FOR
ACHIEVING EXCELLENCE IN HIGHER EDUCATION

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Abstract

Purpose – This paper investigates the fundamentals of self-assessment as a tool of Total Quality Management and examines its potential for *achieving excellence in higher education/improving performance of higher education institutions.*

Methodology/Approach

The paper advances the methodological fundamentals of self-assessment of organizational performance. The different types of organizational measurement procedures in the field of quality management have been examined. The special attention has been paid to the self-assessment as one of the key tool of quality management. The prove has been proven to the principles of self-assessment and the main approaches to understanding the essence and mechanism of the self-assessment implementation have been distinguished. A new definition of the self-assessment has been given on the basis of TQM philosophy and with the focus on effectiveness, strategy and development. Theoretical theses have been supported with the investigation of Mordovia State University experience of self-assessment implementation for evaluating the organizational performance. The results obtained allowed to reveal its advantages and shortcomings and to substantiate the conditions of successful integration of self-assessment with the evaluation system of the University diffusing the TQM principles throughout the organization.

Findings – The paper result has been theoretical and applied findings. The paper summarizes the main approaches to understanding the essence and mechanism of the self-assessment implementation and gives the following definition: self-assessment is as a systematically carried out process of revealing the strengths and competitive advantages of organization, as well as areas of improvement on the basis of fulfilling the fundamentals of the TQM philosophy and definite models of a excellent organization with the aim of increasing effectiveness of the development strategy. The paper discusses the comparative characteristics and key principles of self-assessment as a measurement tool. The applied results of the paper allow to reveal advantages and shortcomings of self-assessment as compared with traditional types of the activity assessment applied at the University. The implementation of self-assessment in the University requires achieving a certain stage of management maturity but it cannot substitute the whole assessment system of the organization. Moreover systematic use of self-assessment requires its integration with the given system providing reciprocal addition and succession of separate types of higher educational institution performance assessment allocating between them spheres and levels to be assessed. It is also necessary to improve organization mechanism for carrying out different types of assessment: firstly, for reducing cumulative administrative load on the basic subdivisions – chairs; secondly, for forming informational basis of making decisions in the field of performance improvement on all the levels and spheres of management.

Originality/Value

1. This paper broaden the methodological basis/approach of self-assessment by integrating it with the key TQM principles.

2. This paper researches the specific features, advantages and results as an integrated part of evaluation system in organization with the main attention paid to the implementation of self-assessment in higher education institutions.

Research Limitation/Implication

To benefit from implementation of self-assessment in the field of higher education the further adaptation of contemporary criteria models is needed to broaden the scope of evaluation in higher education institutions and strengthen motivating and control functions of self-assessment.

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One of the principles of quality management is continuous improvement of the organization performance. This principle means that optimization of the organization productivity and effectiveness needs its work to be carried out on the basis of management of knowledge in the conditions of the created culture of quality, innovation and improvement. Continuous improvement is impossible without periodic analysis of the available potential and the results achieved, which causes the necessity of applying such tool as "self-assessment". The term "self-assessment" came to the management theory and practice from psychology, where it was used within the framework of personology – science dealing with the structure of man's personality. The term "self-assessment" as "the image of himself" was first proposed by William James in 1890 in his book "Fundamentals of Psychology" devoted to the theory of personality (James, 1990). The author distinguished physical, social and spiritual personality and studied feelings and emotions of a man evoked by these elements or his self-assessment which he divided symbolically into "self-satisfaction" and "self-dissatisfaction".

Since the end of the 20th century category of "self-assessment" as "the image of oneself" with some amendments has been applied to the organization, its business processes and performance.(Table I).

Table I – Comparative Analysis of Personality Self-Assessments and Organization Performance

Category	Self-assessment of Personality	Self-assessment of the Organization Performance
1. Aim	Revealing one's merits and disadvantages for self-perfecting and positioning in society	Revealing strengths and areas for improvement, searching possibilities for increasing competitiveness
2. Object	Personal traits and possibilities	Performance of the organization; its structural subdivisions and personnel
3. Subject	Person subjected to self-assessment	The organization personnel subjected to self-assessment and/or a third party
4. Result	Integrated personal assessment, elaboration social relations and the key line of behavior	Integrated assessment of performance, elaboration of strategy for improving the organization productivity and effectiveness

Some researches believe that the appearance of organization self-assessment is connected with the appearance of quality awards (Maslov, 2005). However application of the category "self-assessment" to business processes and organization performance in 1951 within the framework of E.Deming's Prize was not an absolutely new research technique since many published analyses and reports on the results of self-assessment of organizations and assessments of their financial, production and sales processes date from the end of the 19th – beginning of the 20th century. This allows to relate self-assessment to one of the types of measuring the organization performance. In our opinion quality awards contributed to popularization and development of this tool but not to its appearance.

Besides self-assessment there are a whole range of organization performance examination tools implemented in quality management: (Kurakov, Danilov, 2002).

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- assessment – correlation of the object with the accepted criterion, model or norm; determination and analysis of qualitative and quantitative characteristics of the object and the process of management of organization performance;

- inspection – single control activity or examination of the state of affairs in a certain sphere of organization activity; confirmation by means of expertise and objective proofs that the established requirements have been met;

- control – activity including making measurements, expertise, tests and assessments of one of the object characteristics and comparison of the results with the established requirements to determine the correlation between them;

- audit – control of the mechanism and structure of the organization management on the basis of the accepted standards, norms, laws and principles; there is audit of the first party (carried out by the manufacturer or in his name), audit of the second party (carried out by a customer of production or in his name) and audit of the third party (carried out by independent organization);

- self-diagnostics – measurement of indices characterizing the basic components of the company activity in order to reveal probable areas for improvement at the present moment;

- organizational diagnostics – audit of the organizational system, inspection carried out in order to reveal problems of organizations and interconnections between them.

Using the Ph. Crosby approach it is possible to define the extent to which different types of measurement are being applied in Russian companies depending on their maturity stage (Table II).

Table II – The Application of Different Types of Measurements in Russian companies

Type of Measurement	Maturity Stage				
	Uncertainty	Perception	Enlightenment	Wisdom	Certainty
Assessment	–	–	–	–	X
Inspection	–	–	–	–	X
Control	–	–	–	–	X
Audit of the First Party	–	–	–	X	0
Audit if the Second Party	–	–	X	0	0
Audit of the Third Party	–	–	–	X	0
Self-assessment	–	–	X	0	0
Self-diagnostics	X	0	0	0	0
Organizational diagnostics	X	0	0	0	0

Signs: dash - the stage passed; X – application of the given type of measurement corresponds to a definite maturity stage; O – the stage not achieved.

Therefore at the present time along with such traditional types of measuring as assessment, inspection and control, audit of the first and second party as well as certification of quality management systems are widely applied. Gradually self-assessment is becoming popular. At the same time assessment oriented on studying satisfaction of customers and audit of TQM remains at the stage of perception. The stage of uncertainty reflects the extent of using self-diagnostics and organizational diagnostics. It means that in the most organizations there are the lack of understanding of the necessity and possibility of their application.

Self-assessment as a measuring procedure of the organization performance in the sphere of quality management is closely connected with the concept of auditing which consists of a set of rules, making it possible to achieve definite aims and receive confirmation that these rules are applied correctively.

Originated from the quality audit, self-assessment of the organization performance has its own distinctive features today (Table III).

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Table III - Comparative Analysis of Quality Management System (QMS) Audit and Self-assessment of the Organization Performance

Comparative Characteristics	QMS Organization Audit	Self-assessment of the Organization Performance
1. Spheres of measurements	Separate well adjusted spheres of the organization activity (QMS process and elements)	The total organization performance in the sphere of quality management. Integrated tool for assessing TQM-model and QMS organization
2. Aim of measurements	Assessment of correlation of the organization performance to the previously established rules and standards	Assessing the state of the organization and revealing its correlation to its destination. Assessing the productivity and effectiveness of the organization and the maturity level of its QMS
3. Objects of measurements	Measurement of characteristics which can be assessed with a only a certain degree of objectivity	Measurement of "intangible" characteristics difficult for assessment
4. Measuring technique	Well elaborated and adjusted technique	Well elaborated typical measuring technique which requires additional adaptation for each particular organization and personnel training
5. Degree of involving the personnel in the measurement process	Low. Assessment is carried out by a limited number of experts and auditors	High. Assessment presupposes involving all workers of the organization increasing the responsibility and functions of the leaders and personnel.
6. Actions undertaken on the results of measurement	Making conclusions on all the audited items on the basis of statistical assessments and selections. Selection from the list of standardized corrective actions for improving the organization activity	Individual determination of the potential for improving the organization performance

Self-assessment has a wider sphere of application covering all the activity of the organization and involving all the workers. There arise additional difficulties connected not only with increasing number of the object features to be assessed, but also with the necessity of taking into account a lot of "intangible" characteristics hard for measuring and assessing. Typical examples of spheres where "intangible" factors prevail are managing processes and in particular processes of personnel management, the existing organizational culture, problems of leadership. At the same time successful organizations differs from the rest ones mainly by determination "intangible" characteristics, therefore they must be taken into account as the objects for assessment. Self-assessment differs from QMS audit by more distinguishing diagnostic character and special attention to business processes. Naturally the system range of these assessments is wider. Their regularity contributes to developing corporate culture of the organization and at the same time increases its tangibility in understanding its own processes and systems, as well as necessity of corrections for improving its activity.

It is these features that allowed the assessment to become one of the key instruments of the TQM concept paying main attention to a man, social aspects of management and developing the ideas of quality management system, the object of which is not only production but personnel processes and performance of the organization as a whole.

Evolution of the category "organization performance self-assessment" is directly connected with formation of the humanistic management based on the TQM principles and methology of excellence. Therefore self-assessment of the organization performance principally differs from

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other instruments of quality measurement, first of all because it requires involvement of all the enterprise personnel. Within the framework of self-assessment every worker is involved in the improving process and makes a certain contribution to the analysis and diagnostics of the organization performance.

The key principles of organization performance self-assessment activity are given in Table IV.

Table IV - Key Principles of Organization Performance Self-assessment

Principle	The Application of the Principle within the Framework of Organization Performance Self-assessment
1. Results orientation	Most organizations are aware of their financial results but this is not sufficient. Self-assessment allows the organization to measure and forecast needs and requirements of their clients, partners, shareholders, society as a whole, analyze their opinions, study experience of other organizations, collect and process information on the existing and future stakeholders.
2. Customer Focus	The purpose of conducting self-assessment of the organization performance is to increase competitiveness of the organization and satisfaction of customers. Most self-assessment models contain the criterion "customer results" as the most important one.
3. Leadership and Constancy of Purpose	Leaders of the organization must be initiators, organizers and active participants of conducting self-assessment as well as make well grounded decisions according to its results.
4. Management by Processes and Facts	In the course of self-assessment emphasis is made on the analysis and improvement of performance and processes in theof organizations. The results of self-assessment represent objective quantitative and qualitative characteristics reflecting organization strengths and areas of improvement. Effective management decisions are to be made and carried out on the basis of self-assessment results.
5. System approach	Self-assessment and its results play a certain role for the organization as a system as well as for its processes and system levels (in this case we speak not about hierarchical levels, but for instance, about the level of an individual, working groups, subdivisions and the whole organization).
6. People Development and Involvement	This principle is carried out by means of teaching the personnel methods of self-assessment of the organization performance; involvement of employees and groups responsible for its conducting according to various criteria. Thus involvement of the personnel in the process of improvement of the organization performance is carried out.
7. Continuous Learning, Improvements and Innovation	Continuous improvement of the performance is achieved also by systematic carrying out of self-assessment. First of all information is collected. Then analyzed, and after that priorities for carrying out further improvements are determined.
8. Partnership Development	Self-assessment allows to reveal spheres of partnership which require further development and improvement; partners may also be interested in the self-assessment results.
9. Corporate Social Responsibility	Self-assessment contributes to social responsibility of the organization in local and in global scale. Most models of self-assessment include the criterion "society results" which provides examination of various social initiatives and solution of environment protection problems.

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Standard ISO 9004:2000 "QMS. Guidance for Performance Improvement" contains the following definition of self-assessment of the organization performance: self-assessment is a comprehensive assessment resulting in opinions or judgment on the organization effectiveness and the maturity level of the quality management system. Despite this definition at the present time one cannot speak about the existence of a single approach to understanding the essence and mechanism of the self-assessment implementation as well as the reaction of the organization on its results. As a whole we can distinguish the following groups of approaches formed in the modern practice of quality management:

1.Self-assessment as a comparable analysis as compared with the best organizations, some model or standard. This approach possesses some difficulties of choice of a model as well as uncertainty of application of the self-assessment results.

2.Self-assessment as a necessary instrument to apply for the Quality Award. This approach is very wide-spread, however it reduces the role of self-assessment in the process of improving the organization performance.

3.Self-assessment as a diagnostic method of the organization performance review and determination of perspectives of its further development. In this case self-assessment is necessary for revealing strengths and areas for improvement of the organization, possibilities possessed and threats which prevent from realizing these possibilities. Complying as a whole with the content of this approach it is necessary to note its certain limitation. Diagnostics is carried out in the basis of comparison with the planned indices or indices achieved for the last periods of time. The organization here verifies changes made, not comparing its position with the position of environment.

4.Self-assessment as one of the stages of improvement of the organization performance. This approach in fact does not contradict any of the above mentioned ones, includes them as integral parts and is the most integrated and generalized one.

Summarizing these approaches let us determine self-assessment of the organization performance as a systematically carried out process of revealing the strengths and competitive advantages of organization, as well as areas of improvement on the basis of fulfilling the fundamentals of the TQM philosophy and definite models of a excellent organization with the aim of increasing effectiveness of the development strategy.

Self-assessment provides such advantages as:

- receiving objective assessments based on facts, but not on personal perception of personnel,

- appearing a powerful catalyst of quality improvement allowing to reveal and analyze processes in which improvement can be made or priorities for improvement can be established,

- coordinated understanding of what the organization, its subdivisions and each employee must do under the terms of organization policy and strategy,

- training the personnel to use the TQM principles; professional development of the personnel,

- introducing different initiatives and advanced methods of quality management in every day activity of the organization,

- determining the depth of changes taken place since the moment of conducting the previous self-assessment,

- possibility of recognizing and stimulating achievements of subdivisions and employees,

- possibility of comparing with the best results achieved both in this organization and in competitive organizations.

One of the advantages of self-assessment is universality of this method, possibility of its effective application in any organization regardless of the sphere and types of activity. Higher educational institutions are not exceptions. At the present time one of the trends of providing higher education quality is to transfer accent from procedures of external quality control of the educational process and its results on the basis of national systems of certification and accreditation to internal self-assessment of higher school activities based on criteria of one of the existing models. In this

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way responsibility for the quality of the activity performed is completely laid on the higher educational institution itself and it also leads to decreasing the amount of resources used for external expertise.

The Mordovian State University while being a classical University is one of the largest higher education institutions in Russia and also the regional, scientific and cultural centre. It trains students in a wide range of professional programs (79 specialties). The Mordovia State University employs 83 % of scientific and pedagogical personnel in Mordovia. There are 12 faculties, 7 institutes and 3 branches in the University. The University students account for up to 65% of the Mordovia student contingent. It proves that the present and future of higher education in the republic is connected with the development of the Mordovian State University. Quality of education has been in focus during many years of its existence.

For the years of its existing the Mordovian State University has formed a traditional system of the activity assessment that covers educational process, scientific research and non-academic activities. The assessment is carried out at all levels of university management (Table V).

Table V. - Information on the Main Types of Internal Assessment in the Mordovian State University

№	Assessment Type	Content	Responsible Subdivision	Periodicity	Aim
Collection of Information about Customer Satisfaction					
1.	Questionnaire of students tutors, employers and entrants to the University	Assessment of requirements and satisfaction with the main components of the education quality	The Quality Management Department	Annually	Revealing requirements and satisfaction of the parties concerned
2	Questionnaire "Tutors as seen by students"	Assessment of professional and personal traits of tutors	Student Council	Annually	Assessment of satisfaction of students with quality of work of particular tutors
Performance Reports					
3.	Report on fulfilling the planned tasks	Scientific research activity; Educational activity; Publishing activity	Department of Economic Planning	Annually	Control over fulfilling the plan on accreditation indices
4.	Report on publishing activity	Publishing text-books, monographs, articles, methodical instructions	Library	Quarterly	Control over fulfilling plans on publishing educational, methodical and scientific literature
5.	Report on intermediate, current and final student examination	Results of examination of students groups, courses, specialities and departments	Educational and methodical department	According to intermediate and current examination – once in a semester;	Monitoring of specialists training quality

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					according to final examination – once a year
Ratings					
6.	Rating of chair and department	Staff, educational, scientific research and publishing activity	Educational and methodical department	Quarterly	Comparison of chairs and departments on the degree of providing educational process with scientific and pedagogical resources
7.	Rating of a tutor / chair / department	Teaching work; scientific work; work with students; publishing activity; personnel training; advancing qualification	Department of scientific and innovational activity	Annually	Revealing employees having the highest results of activity; determination and rating on this basis the most successful subdivisions
8.	Rating of scientific research and innovation activity	Scientific publications. Training scientific and pedagogical staff. Membership in scientific organizations. Financing scientific work; scientific activity results; students' scientific work. Influence of scientific work on educational process. International activity	Department of scientific and innovational activity	Annually	Ranging subdivisions according to the results of scientific work
Complex Activity assessment					
9.	Self-inspection	Training system of specialists. Content, structure and quality of training specialists. Quality of scientific and methodical work. Quality of methodical, librarian and informative	Educational and methodical department	Once every 5 years	Assessment of the degree of correlation of the activity to requirements of the national standards in the sphere of higher education and

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		support. Material and technical support. Daily life conditions. Educative work. International activity. Financial support				accreditation requirements;
10.	Self-assessment	Leadership. Policy and Strategy. People. Partnership and Resources. Customer Results. People Results. Society Results. Key performance results.	Quality Management Department	Annually		Revealing strengths and areas of improvement. Applying for the National Quality Award in the sphere of higher education.

Thus one can distinguish several directions on which assessment of the performance at the Mordovian State University is carried out:

- assessment of customers satisfaction: students, employers, graduates, parents and entrants to the University;
- control over carrying out planned indices in the field of education, scientific and research, non-academic activities;
- assessment and ranging tutors and subdivisions according to the degree of the effectiveness and productivity;
- self-assessment based on a definite model or criteria system.

Only the first three types of assessment were carried out at the University before 2001. Traditional system of assessment allows to involve almost all professors and teaching staff by means of collecting information on their activity that is later aggregated on the level of subdivisions. The main role in the system of assessment belongs to chairs that provide information accumulation, its primary processing; bear responsibility for its completeness and reliability. Taking into account that the existing system of reporting includes about 200 various indices it overloads the base subdivisions of a higher school, diverts time, labour and material resources for carrying out the assessment. Various subdivisions of the University carry out the assessment within their competence. Therefore different types of assessment duplicate each other, not coordinated in time, their aims and tasks remain unclear for employees. Allocation of responsibility for carrying out various types of assessment at the University (Table VI).

Table VI. - Allocation of responsibility for Carrying out Various Types of Assessment at the University.

Assessment Type	Student	Tutor	Chair	Department	Responsible subdivision
Questionnaire of students tutors, employers and entrants to the University	▨	▨			▨
Questionnaire "Tutors as seen by students"	▨				▨
Report on carrying out the planned activity		▨	▨		▨
Report on publishing activity		▨	▨		▨
Report on intermediate, current and final examination				▨	▨

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of students								
Rating of chair and department								
Rating of a tutor / chair / faculty								
Rating of scientific and research and innovation activity								
Self-inspection								
Self-assessment								

Signs used in the table:

- collecting information
- making a report
- settling a report
- carrying out the assessment procedure

Almost all types of indices that are subjected to assessment in a traditional system reflect the results of the activity. On the one hand this system fulfils a stimulating role, allows to conduct monitoring of results and progress of the organization. On the other hand this system of assessment does not allow to judge about the factors of forming the results and their influence on the parties concerned. Besides self-inspection all the traditional types of assessment applied are not integrated in the improvement planning system.

Introducing of self-assessment became a new stage of assessment system development in the University. Since 2001 its elements have been applied at the Economics Department only. Since 2004 self-assessment in the University has been carried out systematically. The main stages of carrying out self-assessment at the University are given in Table VII.

Table VII - Stages of Carrying out Self-assessment at the University

Stage	Stage contents
1.Preliminary stage (preparation for carrying out self-assessment)	- Taking a decision on carrying out self-assessment, appointing a person responsible for its implementation - Forming a working group for carrying out self-assessment - Selecting a model and methods of self-assessment - Appointing persons responsible for carrying out self-assessment according to different criteria - Training members of the group
2. The main stage	- Collection and analysis of information according to the criteria of the model chosen - Making a summary, considering and approving of it by rector
3. The final stage (making and implementation of decisions according to the results of self-assessment)	- Considering the results of self-assessment at the University Academic Council - Defining the most important priorities for performance improvement - Making a plan of measures for improving priority trends of work - Control over implementation the developed plan of measures

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In 2004, 2005 and 2007 self-assessment was carried out on the basis of the higher educational institution excellence model, developed by the scientists of St. Petersburg State Electric Engineering University.

The main advantage of the given self-assessment model is its simplicity in use, operability in receiving information from officials and employees, possibility of using it on the levels of department and other subdivisions. The generalized results of the University self-assessment are shown in Table VIII (Makarkin, 2008).

Table VIII. The Results of Self-Assessment of the Mordovia State University in 2004-2007

№	Criterion	2004	2005	2007	Trend
01	Leadership	5,9	6,2	6,9	↑
02	Policy and Strategy	6,0	6,0	6,3	↑
03	People	5,8	6,0	6,4	↑
04	Partnership and Resources	6,8	6,8	7,2	↑
05	Processes	5,3	5,6	5,6	→
06	Satisfaction of customers	6,7	6,8	6,9	↑
07	Satisfaction of Personnel	4,9	4,9	5,3	↑
08	Society Results	8,5	8,7	8,7	→
09	Key Performance Results	6,6	6,9	7,1	↑

The table shows that the most part of the criteria shows positive dynamics. Two criteria demonstrate stability: Processes (Criterion 5) and Society Results (Criterion 8). However, the given model of self-assessment does not suppose qualitative grounding of assessments assigned to criteria and categories. Therefore, reports containing detailed analysis of all criteria and categories made annually according to the results of self-assessment. It allows to reveal the areas for improvement according to which the management decisions should be made.

Besides the given model the University has experienced another assessment model with representing qualitative information on the University performance. It was connected with applying for the national quality award in the field of higher education. The University was granted a diploma in 2005 and became a winner in 2006.

The experience of carrying out self-assessment made it possible to reveal its advantages as compared with traditional types of the activity assessment applied at the University:

- self-assessment possesses diagnostic power, allows to reveal strengths and areas for improvement in the University, to find out cause and effect connections between the activity and the factors providing them;

- self-assessment is of strategic character, covers all the main University processes;

- self-assessment allows to assess the quality of management;

- self-assessment is aimed at measuring the University performance from the point of view of the parties concerned, to define the social impact of the University activities;

- carrying out self-assessment usually does not require a lot of time;

- the implementation of self-assessment contributes allows to involve the University personnel.

At the same time from the point of view of management self-assessment has a number of shortcomings:

- the given tool does not allow to assess the successes and contribution of each tutor and subdivision in achieving the University aims;

- the self-assessment model does not contain particular quantitative measurable indices that limits its stimulating influence on the employees activity;

- considerable time resources to carry out the self-assessment does not allow to apply it as a tool of operative management;

- it is difficult to use self-assessment for investigating separate processes of the University–educational, scientific and research and non-academic activities;

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- as a rule, teaching staff is not familiar with the model and methods of self-assessment, misinterpret its results.

Admitting here that implementation of self-assessment in the University requires achieving a certain stage of management maturity one should understand that it cannot substitute the whole assessment system of the organization. Moreover systematic use of self-assessment requires its integration with the given system providing reciprocal addition and succession of separate types of higher educational institution performance assessment allocating between them spheres and levels to be assessed. It is also necessary to improve organization mechanism for carrying out different types of assessment: firstly, for reducing cumulative administrative load on the basic subdivisions – chairs; secondly, for forming informational basis of making decisions in the field of performance improvement on all the levels and spheres of management.

The most difficult problem is transforming self-assessment results into concrete management decisions, measures for system improvement, mechanism and process of strategic management at the University.

The experience shows that the conditions for successful applying self-assessment at the University are:
- active support by the leadership;
- training the personnel in the field self-assessment methods implementation;
- clear allocation of duties and functions;
- wide discussion of self-assessment results in the collective and on different levels of management;
- focus on integration of self-assessment results in the process of strategic planning ;
- monitoring of changes that have taken place since the last self-assessment.

On the basis of self-assessment results of the Mordovian State University performance in 2004-2005 the University strategy for 2006-2010 was added by new priority development directions dealing with the improving of the quality of education and developing the system of the University management.

Strategic priorities of the University development are: (University Strategic Plan, 2006):
- improving quality and widening the spheres of activities;
- transferring to the new type of development based on innovation;
- diversification of financing resources;
- improvement of the University management.

On the basis of self-assessment results has been also defined the strategic goals of the quality management improvement in the University.

Thus self-assessment allows to measure effectiveness and productivity of the University processes; compare it's potential and results for the customers, personnel and society; define the QMS maturity stage, use learning to create innovation and improvement opportunity on the way to the excellence.

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An empirical approach to optimal experimental design selection and data analysis for the synthesis phase of Kansei Engineering

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Abstract

Purpose

Kansei Engineering (KE) is a methodology able to incorporate, systematically and concretely, people's emotions into product design solution, above all in concept design phase. This work aims at testing the appropriateness and the robustness of statistical methods which are at this moment new in KE applications. In particular, in order to reduce the length and the reliability of the evaluation session in Virtual Reality environment, optimal experimental designs and methods of analysis are suggested.

Methodology
Statistical methods are used in each phase of KE. In this work, we focus our attention on the choice of experimental design for the synthesis phase and on the analysis methods for the model building. In particular, we compare the KE results by using classical fractionated designs, with the efficiency of saturated designs and supersaturated designs. Two methods of analysis are tested: categorical regression analysis (CATReg) and Ordinal Logistic regression (OLR). Moreover, a comparison between the results of ranking and rating procedures are discussed for the saturated design.

Findings
The comparison among the suggested statistical methods is performed through a study on railway seats design in a virtual reality environment. The results of the analysis support the use of Fractional Factorial Design instead of saturated and supersaturated design. The two methods of data analysis give the same results. No evident differences emerge from the comparison of rating and ranking procedures.

Value of paper
This paper propose optimal experimental design selection strategies to reduce the number of product concepts to design, test and evaluate, and data collection analysis strategies in order to improve the appropriateness and the robustness of model building phase at the end of the synthesis phase. If applied faster and more reliable, a KE approach can overcome the distrust of industrial designers toward the methods belong to the emotional design area.

Key words : *Kansei Engineering, Saturated Design, Nested Experimental Design, Ordinal Logistic Regression, Categorical Regression.*

Category : Research paper

1. Introduction

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Kansei Engineering (KE) has seen a growing diffusion in the last years among product designers. It is a methodology able to incorporate, systematically and concretely, people's emotions into product design solutions, above all in concept design phase. Part of this increasing interest was due to European and Japanese researchers, that are still working for quantitatively aiding the methodological flow of KE. In this direction, statistical methods can provide a valid support for designers to help them in every critical phase of product development. Some of these methods are already applied in KE studies. However three important considerations should be underlined:

1) the current use of statistical methods is "sparse" in the methodological flow;

2) the main used techniques are the traditional one proposed by KE inventors;

3) the research trend on KE topic reveals a major focus on design methods more than on statistical ones.

These considerations are partly confirmed by the results of a simple survey conducted on the papers presented at the first European Conference on Affective Design and Kansei Engineering, hosted by the 10th QMOD conference in Helsingborg (Sweden). Among the 34 presented papers (25 of which classified as research paper), 10 did not make use on any statistical methods (29%), while the remaining used the methods showed in Table 1. Moreover, only 4 papers made use of experimental design versus the 30 (88%) that did not arrange any design for concept construction and evaluation.

Table 1: Frequency distribution of statistical methods used for the paper presented at the First European Conference on Affective Design and Kansei Engineering (2007).

	Statistical methods	Frequency of use
PCA	Principal Component Analysis	9
QT1	Quantification Theory Type I	6
RSA	Rough Sets Analysis	5
DOE	Experimental Designs	4
PLS	Partial Least Squares	2
FA	Factor Analysis	2
ANOVA	Analysis of variance	2
NPT	Non parametric test	2
LRM	Local Regression Models	1
OLR	Ordinal Logistic Regression	1
CA	Correlation Analysis	1
RD	Robust Design	1
ANOM	Analysis of mean	1

In a previous work (Lanzotti and Tarantino, 2007) the authors underlined the importance of using innovative statistical methods in every phase of KE process, above all in the most critical activities, i.e. the choice of the experimental design in the synthesis phase and the choice of the model of analysis for the collected data. A particular attention was given to Supersaturated Design, a technique for the construction of a reduced number of concept, and the Ordinal Logistic Regression for the analysis of data collected by a Likert scale.

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In this work, the authors emprically compare the level of agreement of *p*-efficient Design with that of classical fractional factorial design and a nested combination of the previous ones. Moreover, Ordinal Logistic Regression (OLR) is compared with Categorical Regression analysis (CATReg). Both methods pursue the same scope, i.e. to find the relationship among predictors variables and response variables when these are categorical in nature, but with a different approach. Moreover, a comparison between the results of ranking and rating procedures is discussed for the *p*-efficient Saturated Design.

The paper is organized as follow. Section 2 describes the main properties of *p*-efficient Design and the principles of Categorical Regression analysis. Section 3 presents the empirical approach for optimal experimental design and data analysis selection in the synthesis phase of KE. Section 4 describes the results of an application of this approach in a case study on railway seats design. The last section is dedicated to discussions, conclusions and the outline of future research.

2. Innovative statistical methods for Kansei Engineering

The diffusion of KE among researchers and industrial designers depends, for a great extent, on the adoption of quantitative methods able to concretely support the decision process above all in the concept design phase. This adoption can be facilitated if:

1) the proposed methods allow a simplification of the experimental effort with the minimum possible loss of information;

2) the proposed methods can be integrated with the other design activities such as tests in Virtual Reality (VR) environment or evaluation sessions involving users;

3) the proposed methods can be easily implemented through the available statistical packages;

4) the results are easy to be interpreted and discussed.

The central role of statistical methods is particular evident in the central parts of the KE procedure, i.e. the synthesis and the model building phases (Barone *et al.*, 2008). For these phases, two statistical methods are here presented: *p*-efficient Design for concept configuration and Categorical Regression analysis for results analysis.

2.1 A class of Saturated Design: *p*-efficient Design

When an experimentation is carried out for testing the impact of k design factors on a response variable (Kansei word), the minimal number n of product concept required to estimate all main effects is equal to $n = k + 1$. In such a case the experimental design is called *saturated*, in the sense we don't have more degrees of freedom to perform other estimations. Saturated Designs, together with the more bound Supersaturated Designs, are useful when it is impossible or inconvenient to prepare several product concept, both from an economical and experimental perspective. This class of design are often used in technological screening situations, where many potential relevant factors are investigated but reasonably only a part of them are active (Box *et al.* affirm that the percentage of active factors is about 25%). The same situation is encountered in product design field, where at the beginning of the project (concept design phase), many design factors should

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be considered but only a small portion of them will be further developed. When $k > n-1$ the use of Supersaturated Design is obligatory (Lin, 1993a), instead when $k = n-1$ Saturated Design should be applied. Among the proposed construction method for Saturated Design, p-efficient Designs have the appealing property of projectivity, i.e. for a subset of design factors it is possible to arrange a design with at least the near equal occurrence and the near orthogonality properties (Lin, 1993b). Moreover, these design are more efficient than D-optimal design for the estimation from the sub-model.

2.2 Categorical Regression analysis

Since the relationship between the response (respondent's agreement on a Likert scale) and the design factors is not linear, the regression model has to take into account this nonlinearity. Two approach can be used in such a case: Generalized Linear Models (McCullagh and Nelder, 1989) and Regression with transformation (Kruskal, 1965). In the first approach, a non linear function (link function) is used for linearizing the non linear relationship among response and predictors. Ordinal Logistic Regression belongs to this class of models. In the second approach, the relationship between the response and the predictors is linearized through separate nonlinear transformation of the variable (both non-monotonic or monotonic trasformation). In particular, by using optimal scaling it is possible to quantify categorical variables (nominal or ordinal) and at the same time optimize the relationship between response and predictors. Categorical Regression belongs to this class of models (Meulman, 2003). Even if, many preliminary decisions have to be considered before to perform this model (as the properties of the original variable to be preserved with the transformation), the results are more similar to those of linear regression and thus easier to be interpreted in comparison with Ordinal Logistic Regression. For example, the squared multiple regression coefficient R^2 and the regression coefficients assume the same form that in the case of linear regression analysis, while in Ordinal Logistic Regression Log-likelihood ratio test and odds ratio are used respectively. Moreover, Categorical Regression is nowadays implemented in statistical software as SPSS® and R (isoreg function). The case study will clarify how to interpret the result of CATReg.

3. Empirical approach for experimental design and data analysis selection

In some experimental situations, the reduction of the number of product concepts to model and, subsequently, to evaluate in a virtual environment, can determine the success of the evaluation session in terms of respondents' involvement and then reliability of results. However, this reduction is always paid in terms of loss of information and predictive ability of the built model. The trade off between the experimental effort and the results validity needs to be supported by methodological test able to indicate the most suitable experimental design and data analysis. The proposed approach is here described for the case of five design factors. However, its extension to a more general experimental situation is straightforward. As a general consideration, the more the number of runs in an experimental design the more the ability of the design to detect active factors. By following this reasoning a p-efficient Design with six run (a Saturated Design in this case) is compared with a 2_{III}^{5-2} fractional factorial design. These design have common runs (combination of factors level), so they can be nested in a 12-run experimental design (Table 2). This design constitutes the benchmark for the evaluation of individual design.

Product concepts, built according to the indication of the 12-run experimental design are then evaluated by respondents in a virtual environment on a five-point Likert scale. Ordinal Logistic Regression and Categorical Regression are both applied to the three designs in order to compare the results of these analysis in all the experimental situations. Moreover, a ranking procedure is performed for a 6-runs *p*-efficient Design. By comparing the results of ranking and ratings by using Categorical Regression with that obtained from 12-runs experimental design, it is possible to have an indication of which scale respondents prefer for evaluating product concepts.

4. A case study on railway seats design

The empirical approach for the choice of optimal experimental design and data analysis method is exploited in a study on new seats design for a regional train. It was developed at the University of Naples "Federico II" by involving undergraduates students of Faculty of Mechanical Engineering, attending the course of "Industrial technical design".

Table 2. Experimental design used for the empirical choice of design and technique of analysis.

Run	A	B	C	D	E	$y_{rat.}$	rank
1	-1	1	-1	-1	-1	y_1	r_1
2	-1	-1	-1	1	1	y_2	r_2
3	1	1	-1	1	1	y_3	r_3
4	1	-1	1	1	-1	y_4	r_4
5	-1	1	1	-1	1	y_5	r_5
6	1	-1	1	-1	-1	y_6	r_6

+

Run	A	B	C	D	E	y
1	-1	-1	-1	1	1	y_2
2	1	-1	1	1	-1	y_4
3	-1	-1	1	1	-1	y_7
4	1	1	-1	1	-1	y_8
5	1	-1	-1	-1	-1	y_9
6	1	1	1	1	1	y_{10}
7	-1	1	1	-1	-1	y_{11}
8	-1	1	-1	-1	1	y_{12}

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Run	A	B	C	D	E	y
1	-1	1	-1	-1	-1	y_1
2	-1	-1	-1	1	1	y_2
3	1	1	-1	1	1	y_3
4	1	-1	1	1	-1	y_4
5	-1	1	1	-1	1	y_5
6	1	-1	1	-1	-1	y_6
7	-1	-1	1	1	-1	y_7
8	1	1	-1	1	-1	y_8
9	1	-1	-1	-1	-1	y_9
10	1	1	1	1	1	y_{10}
11	-1	1	1	-1	-1	y_{11}
12	-1	1	-1	-1	1	y_{12}

4.1 Design factors selection

The study of seat design for regional transport was initiated with a previous work (Di Gironimo *et al.*, 2008). There, the authors focused on the deep separation between the style and the engineering activities. Moreover, it was underlined the difficulty of identifying the user needs through the only adoption of Kano model. Starting from the results of that work, five factors are here selected in order to improve the users' needs identification phase through the adoption of a KE procedure. For each factor two different design solutions were characterized, assumed as levels for the experimental design (Table 3). These five factors span the space of characteristics for the KE analysis.

Table 3. Experimental design tested for the best choice of design and technique of analysis.

		Levels	
Design Factors		**-1**	**+1**
A.	Style	Yesterday	Today
B.	Direct Light	Posterior	Lateral
C.	Folding table	No	Yes
D.	Armrest	Fixed	Mobile
E.	Footrest	No	Yes

According to the experimental design of table 1, twelve virtual concepts were generated in a 3D CAD environment complied with standards. Figure 1 shows an example of seat concept.
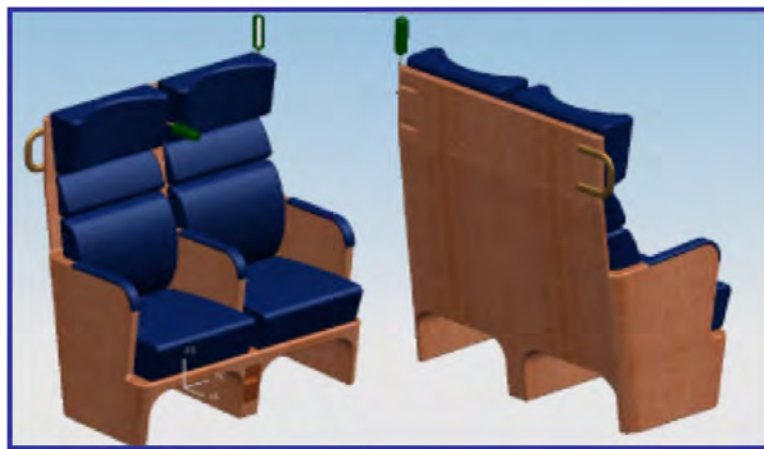
Figure 1: Two sides of concept 1.

4.2 Evaluation session

To identify the correlation between the physical properties of seat design and the Kansei word *"Comfortable"*, an evaluation session was performed at the Faculty of Engineering. Twenty students were asked to express their opinion about each concept, randomly showed on a pc desktop. The respondents were nearly 22 years old. Moreover, the 70% of them regularly uses regional trains while the 50% almost every day.

For the rating analysis each concept was displayed in a dynamic way, with the possibility of a virtual navigation around the seat. The students could state their opinion on a five-point Likert scale. For the ranking analysis the concepts were all simultaneously displayed (Fig. 2) in order to give to respondents the possibility of classifying them.

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Figure 2: The concepts showed for the ranking analysis.

4.3 Analysis of experimental results

The collected data were analyzed by MINITAB® and SPSS®. These software are both able to perform Ordinal Logistic Regression and produce almost the same report. However, they have different additional options of analysis. In particular, MINITAB® produces summary measures of association between response variables and predicted probabilities, while SPSS® performs the important test of parallel lines (for verifying the hypothesis of same slope coefficients across response categories) and pseudo R-square. All the Ordinal Logistic Regression models fitted well data (Pearson and Deviance Goodness of fit tests > 0.05) and were significant (Log-likelihood ratio test with p-values less than 0.05). An example of Ordinal Logistic Regression output can be found in (Barone *et al.*, 2007). Categorical Regression was instead performed by SPSS® (Optimal Scaling). The results of CATReg for the 12-runs design are summarized in Table 4. The selected scaling level for response variable was numerical whereas design factors were leaved as nominal. The multicollinearity among predictors was not a concern (high values into tolerance column). The *F*-test for design factors indicates if omission of the corresponding factor from the model, with all other factors present, significantly worsen the predictive capabilities of the model. In this case, design factors A, C, D and E are important. The relative importance of the design factors are also calculated by the Pratt's measure (Importance column), with the four significant factors accounting for the 99.8% of the importance. Moreover, by squaring the value in the part correlation column, it is possible to measure the proportion of variance explained by factor relative to the total variance of response. Even if, the regression of design factors over response variable is statistical significant (*p*-value of *F*-test less than 0.05), the multiple regression coefficient

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is quite low. However, this value is strictly connected to the selected scaling level of variables. In general, more restrictive transformation (properties of variables persevered during transformation) results in less fit. In summary, the results of CATReg model applied to the data from the 12-runs experimental design are quite significant. The same analysis was executed with the other three design and also for the ranking procedure. The active factors detected with the whole procedure are summarized in Table 5.

Table 4. Summary of CATReg output with the 12-runs design for Kansei word *Comfortable*.

	Standardized coefficents					Correlations				
	Beta	s_{Beta}	Df	F	p-value	Zero-Order	Partial	Part	Importance	Tolerance
A	-0.213	0.053	1	16.2	0.000	-0.252	-0.254	-0.195	0.119	0.834
B	0.011	0.054	1	0.038	0.846	0.123	0.013	0.009	0.003	0.796
C	0.450	0.049	1	82.93	0.000	0.369	0.512	0.441	0.368	0.956
D	0.128	0.054	1	5.52	0.020	0.134	0.152	0.114	0.038	0.793
E	0.470	0.056	1	71.65	0.000	0.455	0.484	0.409	0.473	0.759

	SS	MS	Df	F	p-value	Multiple R	R^2	R^2_{adj}
Regression	108.6	21.7	5	38.67	0.000	0.673	0.452	0.441
Residual	131.4	0.562	234					
Total	240.0		239					

Table 5. Active factors resulting from the analysis of OLR and CATReg with the studied design

	Rating		Ranking
Design	OLR	CATReg	CATReg
6-runs *p*-efficient	B-C-E	C-E	A-B-E
2^{5-2}_{III}	A-C-D-E	A-C-D-E	
12 run nested design	A-C-D-E	A-C-D-E	

Ordinal Logistic Regression and Categorical Regression produce similar results in all experimental situations. The only exception is for the 6-runs design. However, factor B was nearly significant with OLR and was not nearly significant with CATReg. With the other designs the two methods produce identical results also for the strength of factors' significativity. Fractional factorial design works better than 6-run p-efficient Design if compared with the 12-runs design. The addition of only two runs allows experimenter to detect the same significant factors than with the 12-runs design. No evident solution seems to emerge from the comparison between rating and ranking procedure. In both model two significant factors emerge, i.e. C and E in rating procedure and A and E in ranking procedure. However, in ranking model also factor B emerges as significant. This is consonant with the results of 6-runs *p*-efficient Design but different from the indication of 8-runs and 12-runs designs.

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4.4 Confirmatory study

From the previous analysis the classical Fractional Factorial Design turned out to be better than *p*-efficient Design for detecting the active factors. To confirm this results a new simplified experimental phase was carried out. In particular, the same factors of the previous analysis (Table 3) were used except for the factor A "*Style*", fixed initially at its low level ("*Yesterday*") and then at its high level ("*Today*"). In this phase a 2_{IV}^{4-1} Fractorial Factorial Design (FFD) was compared with a Supersaturated Design (SSD) nested in it and generated according to (Lin, 1993a) (Table 6).

Table 6. The classical Fractionated Factorial Design (left) and a Supersaturated Design (right).

Run	D	B	E	C	y
1	-1	-1	-1	1	y_1
2	-1	-1	1	-1	y_2
3	-1	1	-1	-1	y_3
4	-1	1	1	1	y_4
5	1	-1	-1	-1	y_5
6	1	-1	1	1	y_6
7	1	1	-1	1	y_7
8	1	1	1	-1	y_8

Run	D		B	C			E				y
1	-1	1	-1	1	1	1	-1	-1	-1	1	y_1
2	1	-1	-1	1	-1	1	1	1	-1	-1	y_6
3	-1	1	-1	-1	1	-1	1	1	1	-1	y_2
4	-1	-1	1	-1	-1	1	-1	1	1	1	y_3
5	1	1	1	-1	-1	-1	1	-1	-1	1	y_8
6	1	-1	1	1	1	-1	-1	-1	1	-1	y_7

The generated 8 product concepts were shown in an immersive Virtual Reality environment at the Virtual Reality laboratory of the Competence Center for the Qualification of Transportation Systems founded by the Campania Region. Fifteen students of the Faculty of Industrial Design at the Second University of Naples were asked to give their opinion about each product concept on a ten-point Likert scale. The collected data were analyzed through Pareto Anova. The results (Table 7) underline once again the different results obtainable by classical Fractionated Factorial Design and Supersaturated Design. In particular, in both cases of style, Supersaturated design produced discordant results both in terms of active factors and strength of importance. These results, even if in a particular case, confirm the inadequacy of Supersaturated Design in experimental context with non-metric scale and highlight the Fractionated Factorial Design as the best design for detecting the active factors.

Table 7. The results from the Pareto Anova.

Style	Design	Pareto Anova			
Yesterday	FFD	C	E	D	B
		63%	20%	14%	3%
	SSD	C	D	B	D
		43%	34%	14%	9%
Today	FFD	C	E	B	D
		50%	35%	14%	1%
	SSD	D	C	E	B
		64%	26%	9%	1%

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5. Conclusion and Discussion

This paper proposes an empirical experimental design selection strategies to reduce the number of product concepts to design, test and evaluate, and data collection analysis strategies in order to improve the appropriateness and the robustness of model building phase at the end of the synthesis phase. In this strategy two design with a similar number of runs are nested in a 12-runs experimental design. According to the run of this design twelve product concepts were built and evaluated into an immersive Virtual Reality environment on a five-point Likert scale. A ranking procedure was also performed for the 6-runs design. The results of Ordinal Logistic Regression and Categorical Regression are concordant and indicate that classical Fractional Factorial Design works better than saturated Design in terms of ability to detect active factors. This result was confirmed by a simplified experimental session in which Fractional Factorial Design was compared with Supersaturated Design. All conditions being equal, Categorical Regression presents an output similar to that of linear regression and easier to interpret if compared with that of Ordinal Logistic Regression. Moreover, since *p*-efficient Design are applied in technological field, the poor results can be due to the use of non-metric response variable. The comparison among ranking and rating procedure for the 6-runs design does not solve the dilemma about which methods to use in respondents evaluation session. However, the poor results of this test can be due to the correlation pattern of the 6-runs design, heavily biasing the estimation algorithm in CATReg. Since the choice of performing a rating procedure rather than a ranking one is critical, further researches need to be carried out in this context.
If applied faster and more reliable, a KE approach can overcome the distrust of industrial designers toward this methodology belong to the emotional design area. Researches for the choice of optimal experimental design and the most suitable methods of analysis address this goal.

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Affective Engineering Approach to

Understand Servicescape Effects

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Abstract

Purpose – Although numerous articles emphasize the importance of servicescape, methodological approaches to understand and reflect affective needs of customer and employees to the design of the servicescapes have not been fully captured by the existing studies. The aim of the paper is twofold. First is to discuss the role of affective engineering for servicescape design and second is to explain the underlying structure of Kansei (feeling) and related design attribute interactions based on design of experiments modelling.

Methodology/Approach- In this research, the Affective (Kansei) Engineering is proposed to examine the interaction between servicescape design attributes that may affect affective values for the service itself and the service provider. Further a case study is presented applying Affective engineering to identify and design a certain feeling found as important for a servicescape environment.

Findings- The role of Affective Engineering methodology is discussed in a framework for management on how the servicescape be designed to distinguish between functional and affective dimensions (Kansei) of the servicescape and to show how the two dimensions interact. It is suggested that interaction between designs attributes need to be considered to understand and reflect human feelings in servicescape design.

Research limitations/implications- This paper discusses a framework on integrating Affective Engineering methodology.

Practical implications- This study provides useful insights for integration of affective needs for design of physical surroundings of services.

Originality/value-This paper makes an original contribution to propose Affective Engineering methodology for management considerations on design of servicescapes.

Keywords: Service quality, Kansei interactions, design attribute interactions

1. Introduction

Customers judge the quality of services based on their perceptions of the *technical outcome* provided, *the process* by which that outcome was delivered and *the quality of physical surroundings* where the service is delivered (Zeithaml and Bitner, 2003). Service quality is a focused evaluation that reflects the customer's perception of elements such as interaction quality with the staff, physical environment quality and outcome (technical) quality (Brady and Cronin, 2001).

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There exist about 20 different service quality models in the literature (Seth et al., 2004). An overview of these models highlights that the customer's expectations towards particular services change with respect to factors like time, increase in the number of encounters with a particular service, competitive environment, etc (Seth et al., 2004).

In one commonly cited of service quality model approaches, the service quality dimensions are defined by Grönroos (1998) as *what the customer receives* and *how the customer receives*; respectively the technical result or outcome of the process (outcome quality) and the functional dimension of the process (functional quality). One of the most applied service quality models in the literature proposed by Parasuraman et al. (1988) defines five dimensions of service quality as *reliability, responsiveness, assurance, empathy and tangibles*.

In addition to that Grönroos (2001) proposes that the dimension *where* needs to be added to the "*what* and *how* dimensions of service quality" (based on Rust and Oliver (1994)). This dimension can be labelled as "servicescape quality" (Grönroos, 2001). The term servicescape was introduced to the service marketing literature by Bitner (1990) to represent physical surroundings in which a part of healthcare services are delivered, perceived and where the health staff and patients interact and to describe various elements of the physical environment of the service encounter.

This study thus focuses on the servicescape dimension of the service quality. The servicescape or service setting plays a critical role in shaping customer expectations, differentiating service firms, facilitating customer and employee goals, and influencing the nature of customer experiences (Bitner, 1992). An extensive review by Dijkstra (2006) points out the possible interactions between different environmental stimuli, and it is likely that the effects of different environmental stimuli will reinforce or weaken another.

In this research, the Affective (Kansei) Engineering methodology is proposed to examine the interaction between servicescape design attributes that may affect affective values for the service itself and the service provider.

The overall aim of this study is to discuss the role of Affective Engineering as a methodology for servicescape design. The aim of the paper is twofold. First is to discuss the role of affective engineering for servicescape design and second to explain the underlying structure of Kansei (feelings) and related design attribute interactions based on design of experiments modelling. Further a case study is presented applying affective engineering to identify and design certain feelings of a servicescape environment.

The plan of this paper is as follows. Section 2 describes a framework that proposes Affective Engineering as a methodological approach for an integrated servicescape framework. In Section 3 Kansei (feelings) and factors presented in the framework have been modelled by experimental design to show the complex interactions of Affective engineering. Next in Section 4 a case study based on an empirical investigation is proposed to approach the problem of interaction complexity for feelings and design attributes in the servicescape. The paper is concluded with theoretical and practical implications of the study.

2. Proposed Framework

A framework for management on how can the servicescape be designed to enhance customer satisfaction and retention is suggested in Figure 1. This revised framework from Bitner (1992, 2000) integrates the social environment as a dimension of the servicescape and explicitly acknowledges the

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reciprocal and transactional relationship between environmental influences and human behaviours (Bitner, 2000).

The framework consists of three key management questions *what can be controlled, what can be understood in a servicescape* and *what are the desired outcomes*.

As can be seen from Figure 1 there is a need to distinguish between functional and affective dimensions (Kansei) of the servicescape and to show how the two interact. Therefore as a methodological approach to understand the desired outcomes stated in the framework the Affective Engineering methodology to understand employee and customer responses to the servicescape is suggested.

The Kansei Engineering methodology is suggested to examine the interaction between servicescape design attributes that influence affective values of servicescapes. In further sections the framework and the role of Affective Engineering will be described and a case study will be presented.
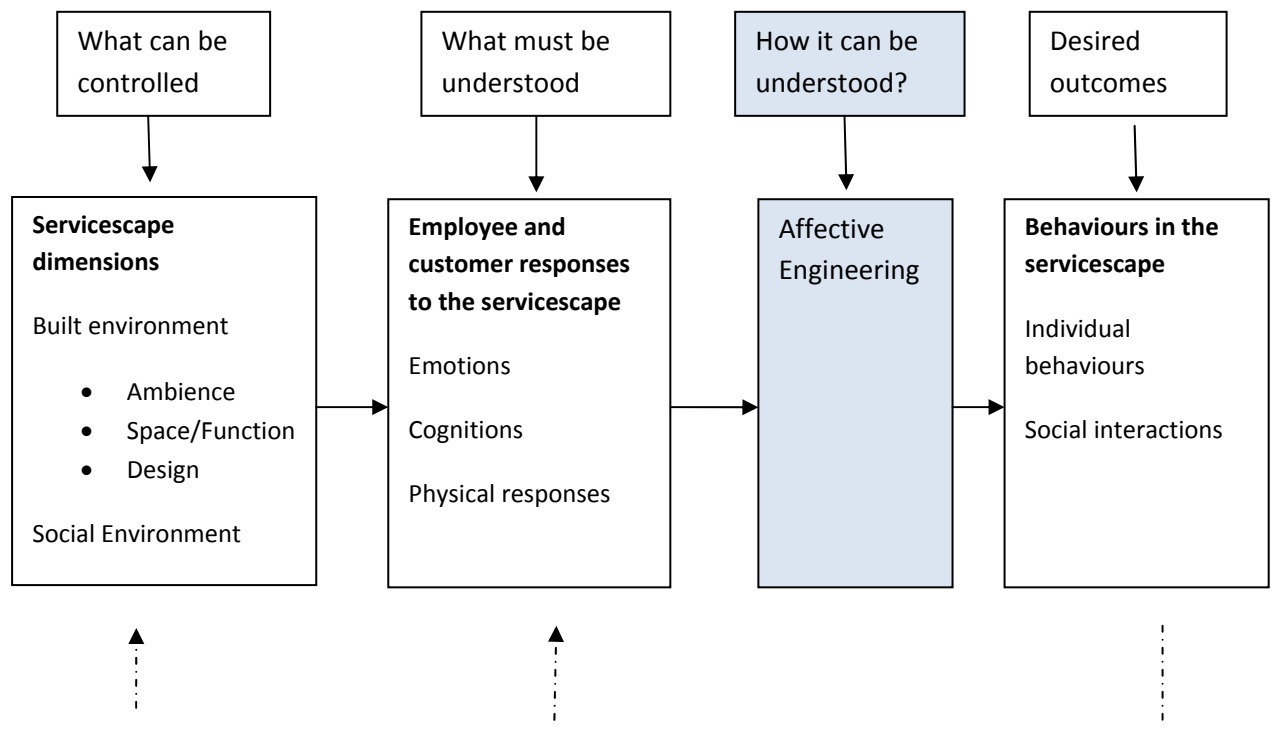
Figure 1. The servicescape: An integrated framework for managers

What can be controlled in servicescapes?

The physical and the social environment are the two controllable aspects which, individually and as well interaction wise, have an effect on the customer's experiences from the servicescape. According to Bitner (1992), the physical environment is considered in terms of three physical factors: the ambient conditions; the spatial layout and functionality; and the signs, symbols and artefacts.

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Ambient conditions consist of background characteristics of the environment such as temperature, air quality, noise, music, odours, scent and colour, while space and function includes layout, equipment and furnishing (Bitner, 2000).

All of these factors may profoundly affect how people feel, think and respond to a particular service environment based on our five senses (Bitner, 2000). Mood-enhancing strategies by testing different stimuli in this way have shown considerable results such as women exposed to orange odours found to have a lower level of state anxiety, a more positive mood, and a higher level of calmness in dental waiting rooms (Lehrner et al., 2000). High and large windows with pleasant views or pictures on the waiting room walls proved to yield positive effects in waiting rooms (Cameron et al., 2003). Use of music was related to decreased stress and increased relaxation in comparison to times with no music (Routhieaux and Tansik, 1997), and using poems in the waiting room enhanced the experienced value of the patient's visit to the waiting room (Tyson et al., 2002).

The majority of research on care environments has employed experimental designs to test different environmental variables, for example sound, colour and architecture, in relation to patient outcomes such as recovery, pain and blood pressure (Edwardsson et al., 2006). There is, however, little research-based understanding of the meanings of being in these environments.

The influence of the social environment may also determine both the customer's internal response and outward behaviour (Tombs and Mccoll-Kennedy, 2003). In addition to customer, employee and environment interaction the interaction with other customers in the environment may also play a role in the perception and satisfaction of the servicescape (Bitner, 2000).

What must be understood in servicescapes?

In order to manage the physical and social dimensions of the servicescape the emotional, cognitive and physical customer and employee responses to the servicescape must be understood. From a cognitive perspective servicescapes can effect the beliefs about product and services, and may also have emotional effects on customers and employees that affect their behaviours and feelings for the service and the environment (Bitner, 2000).

How employee and customer responses to the environment can be understood?

In order to understand servicescape effects, environment surveys, direct observation, experimental methods and photographic blueprints are used (Zeithaml and Bitner, 2003).

Environment surveys ask people (customers or employees) to express their needs and preferences for different environmental configurations. An advantage of these surveys is that sample size can be large and many environmental variables can be explored simultaneously; the primary disadvantage of such surveys is that the results may be less valid then other methods because the survey questions and answers may not truly reflect how people feel or how they will behave.

The advantage of direct observations is that it is done by highly trained observers making detailed notes of environmental conditions. The disadvantages are primarily relates to time and costs, and if observers can interpret the environment in a right way.

The experimental method involves groups of customers exposed to different environmental configurations and measurements of their reactions. The advantage of this method is the validity of results. Disadvantages are time and costs.

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Photographic blueprints provide a visualization of the service to the customer at each step and are useful for unambiguous documentation of the physical evidence of the service.

It is important to take affective responses into account in service quality evaluations (Grönroos, 2001). The scales used in literature, such as SERVQUAL (Parasuraman et al., 1988), PANAS (Watson, 2000), cover just limited exploration of moods related to service quality dimensions. Moods may have positive or negative effect on customer's evaluations. However emotions that customers feel when consuming a service have not been included in service quality models or in models for measuring satisfaction of services (Grönroos, 2001). Method developments seem to be needed in this area, and an approach for such development is presented in case study. Exploring the interaction effects of design attributes for a servicescape in relation to affective judgements have not been captured fully by the methods suggested in the literature (Osgood et al., 1957; Küller, 1980, Russel et al., 1981).

Considering the methods presented above, to get associations of the relation of service and physical environment design features to customer feelings and values, comprehensive methodological approaches are needed.

3. How customer and employee responses be understood in servicescapes?: Affective Engineering

In this study Affective (Kansei) engineering is proposed as *a methodology to understand and address employees' and customers' emotional needs*. In recent years affective design has increasingly been applied in product development to fulfil customers' and users' emotional needs and preferences. Emotions are in Japanese referred to as "Kansei", which is defined as "an individual's psychological feeling and image resulting from a series of information processes from a certain artefact, environment, or situation" (Nagamachi, 1999).

In Japan the translation terminology for "Kansei" draws back to Amane Nishi (1829-1897), the first person who used Kansei as a philosophical term for "sensibility" (Nagasawa, 2004). In 1921, Teiyu Amano used the German term "Sinnlichkeit" (sensitivity) in Critique of Pure Reason (Kant, 2003) to translate the word Kansei. As an opposite term of Kansei "Risei" (close to "Logic process", reason (Nagasawa, 2004) is also argued by Levy (2007).

However the words "sensitivity" and "sensibility" alone are not exact meanings of Kansei. It is argued that 'to Kansei' means "to feel to the core" (Nagasawa, 2004). The word of Kansei, if used in engineering and business, should be considered to be a series of information processing processes of sensation, perception, cognition, sentiment and expression (Nagasawa, 2004).

Kansei later is described by Nagamachi (2001) as a Japanese word for "individual's subjective impression from a certain artifact, environment, or situation using all the senses of sight, hearing, feeling, smell, taste as well as recognition". It is then explained as the mental process of experiencing the product and described as "psychological feelings and image regarding a product" (Namagachi, 2002).

"Kansei" feelings can be captured in several ways, according to Nagamachi (2001):

- People's behaviours and actions.

- Words (spoken).

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- Facial and body expressions.

- Physiological responses (e.g. heart rate, body temperature).

Kansei Engineering is widely used in Asian region, while there is no single unified word for Kansei Engineering in English or western countries. The German philosopher Baumgarten and his work AESTHETICA (1750), which was the first study that influenced Kansei Engineering (Harada, 1997). However, current Kansei Engineering is defined as the transdisciplinary engineering that extends over humanities, social and natural science. (www.jske.org, 2004). Mr. Ken'ichi Yamamoto, Former President of Mazda Motor Co used "Kansei" (1986) in international context when giving lectures on the design success of Japanese cars by Kansei Engineering in U.S.

Kansei Engineering was proposed as a methodology for affective design of products in the early 1970'es (Nagamachi, 1995). The methodology aims at translating human psychological processes, such as feelings and emotions, into appropriate product design elements, such as size, shape, and surface characteristics. The main challenge of this methodology originates from difficulties in mapping Kansei to perceptual design elements (Jiao et al., 2006).

The most common tools for linking the Kansei feeling words with physical product attributes are:

- Regression Analysis /Quantification Theory Type I (Komazawa and Hayashi, 1976 Nagamachi, 2001)

- Genetic Algorithm (Nishino et al., 1999, Tsuchiya et al.,1996; Tsuchiya et al., 1999)

- Fuzzy Sets Theory (Shimizu and Jindo, 1995; Tsuchiya et al., 1996)

- Neural Networks (Ishihara et al. 1995; 1997, Chen et al., 2006)

- Rough sets analysis (Nishino et al. 2001; Nagamachi et al., 2006; Nishino et al., 2006; Okuhura et al, 2005)

If it is assumed that a set of high level words about feelings (kansei) represent emotional needs are determined (see above discussion on Kansei and common tools for Kansei Engineering), *what are the ways to identify and choose between important aspects in relation to give design solutions for servicescape design?*

Figure 2 below may be seen as a model of the value chain in a person's mind consisting of Kansei/ feeling characteristics and the related attributes of the product(including services). The model shows a grouping of feelings, their interactions and the design attribute interactions for certain feelings.

Looking at the extracted feelings specifically consider the interactions between feelings in the first level and the upper level interactions with their (2, 3,.., n) relative design attributes are examined.

The highest level of affective values can be explained as "core Kansei" to show high level feelings representing values for a servicescape.

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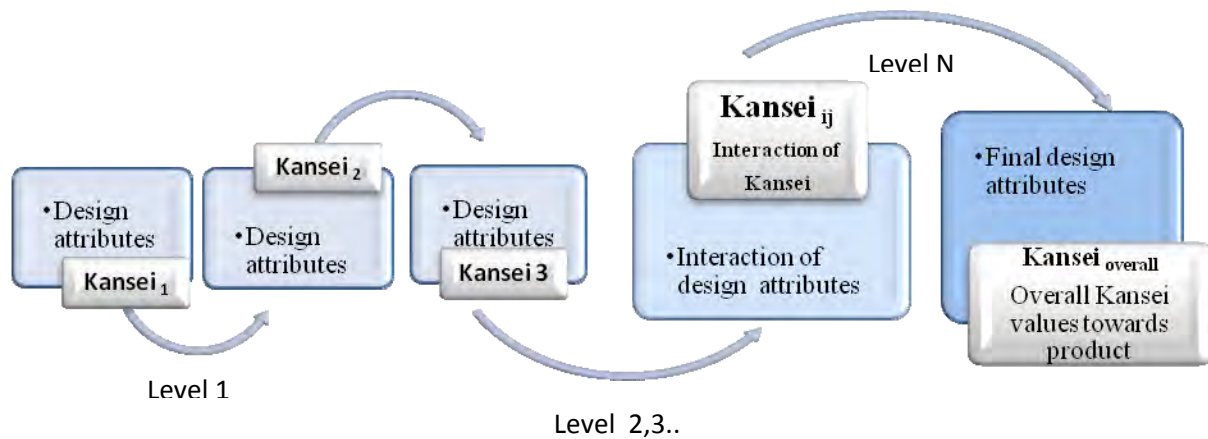
Figure 2. Kansei value chain model.

To explain the role of Affective Engineering waiting areas were selected to study servicescapes (Ayas et al., 2008). The study was undertaken at six primary healthcare centres representing socially and regionally distinct areas in the Östergötland county of Sweden. The aim of the case study was twofold. The first aim was to explore how patients relate their affective responses to physical and service design attributes in waiting areas. The second aim was to identify interactions between physical design attributes and affective values.

As an example the set of high level Kansei Feelings for design of waiting rooms were obtained as: calming, welcoming and safety-security. These feelings were obtained in a previous study (Ayas, 2008) from the commonly desired feelings for patients and staff. We can assume that these feelings represent the highest level of Kansei.

According to the study results to give calm feeling to the patients *privacy, colours, plants, location of play areas for children good design of lighting, small sitting groups and minimal noise* are interacting design attributes.

To give welcome feeling the previous study results show that *nice and comfortable furniture, warm colours and staff behaviours towards patients* are important.

To give safety-security feeling *stable furniture, easy to access to the facilities and staff attention* are important.

It can be seen from the specific characteristics for each type of feeling presented above that some attributes interact with each other. Small sitting groups are needed to give *calm feeling*, however to give *welcome feeling* and to give *security feeling* the furniture characteristics chosen need to be comfortable and need to be stable.

As described above the level of a design attribute (a) for a Kansei feeling (K1) may have opposite interaction with the selected level of another design attribute (b) which is necessary for another desired feeling (K2) (see Figure 3).

Appropriate solutions in such an engineering problem may require justifying product attribute levels to optimize the contrary interactions. Moreover to apply a creative problem solving tools such as Heuristic Redefinition, Classic Brainstorming, Brainwriting 6-3-5, Imaginary Brainstorming, Word Picture Associations and Analogies, TILMAG, Morphological Box, for design of a new physical attribute if the attribute levels chosen are not adequate enough or if they do not exist.

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As an example for furniture design in waiting rooms a comfortable armchair can be needed as both soft or hard to keep human body stable. The design of such an armchair may require different product characteristics for hygiene and comfort which interact with softness or hardness of the material.
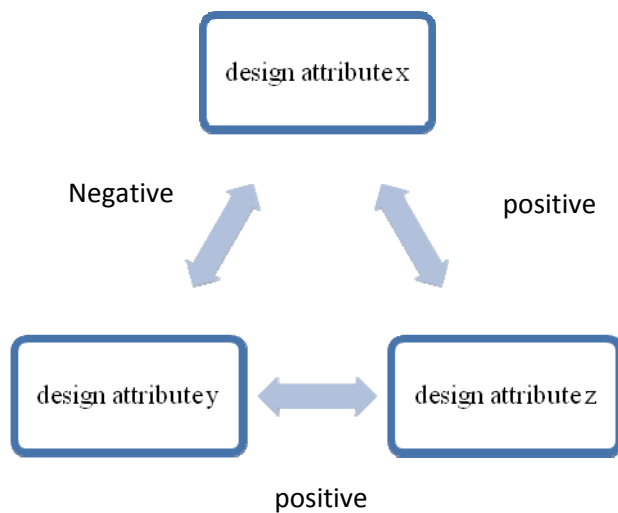
Figure 3. e.g. Representation of some possible correlations between 3 design attributes.

The problems related to the possible interactions presented above are formulated in the following sections with a Design of Experiments approach (DOE).

In complex products the knowledge of interaction between feelings are more useful compare to understanding main Kansei factor effects. To give an example; high level of calmness can be related to high level of privacy and low level of bracing feeling in a service environment. To wrap up this discussion arousing and calming states interact with each other, they do not exist alone in a person's psychological state.

The different levels for Kansei can also be explained as shown below. According to this assumption e.g. second level Kansei is comprised of second level interactions. Third level Kansei is comprised of second and third level interaction effects and so on.

If we think about the waiting room example the three feelings identified with this study are calm, welcome, safety-security. Overall Kansei is assumed to be comprised of these feelings.

The second level interaction helps us to consider the possible effects of interaction between calm and welcome feelings and what the combination of two feelings means for patients. This feeling structure can give us a learning of a higher level perception on human Kansei. As an example a low level of calm feeling may have a negative effect on welcome feeling therefore we learn that to give calm feeling is related to convey welcome feeling in the waiting rooms.

The third level interaction helps us to consider the possible effects of interaction between calm, welcome and safety security feelings and what the combination of three feelings means for patients.

Each person relates his/her Kansei to different product attributes where there are possible interactions between those attributes that need to be considered as explained below. Therefore Kansei research approach take into account such product design complexity.

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If the aim is to understand the overall Kansei, the objective function for such an engineering problem is considered to include possible feelings for Kansei. The objective function may change according to the aim with the study.

In the following phrases we can see several Kansei feelings that construct the desired Kansei for a product and each feeling is connected to a possible combination of design attributes and their interactions. The engineering problem here is how to choose the design parameters from *within and between interactions* of design attributes. Let's assume that following design attributes are needed for design of following Kansei feelings in waiting rooms. The design attribute *lightning* interacts both for calm, welcome and safety-security feelings in the environment.

- calm⇨less lighting&warm colours&soft seating material

- welcome⇨ lighting&staff behaviours

- safety-security⇨ stable furniture& easy to access to the facilities&staff behaviours

4. Case Study

Developing healthcare services from an understanding of patients' needs in waiting areas is a growing concern (Arneill and Devlin, 2003; Leather et al., 2003). However, exploring Kansei values and needs for design of waiting areas in primary healthcare are not given the same emphasis.

Waiting environments were selected to study servicescapes (Ayas et al., 2008). The study was undertaken at six primary healthcare centres representing socially and regionally distinct areas in the Östergötland county of Sweden. The aim of the case study was twofold. The first aim was to explore how patients relate their affective responses to physical and service design attributes in waiting areas. The second aim was to identify interactions between physical design attributes and affective values.

A qualitative research with face to face interviews was conducted in the waiting rooms of selected healthcare centres. The earliest interviews in the first healthcare centre played an important role to get a sense about the number of interviewees. The total number of patients interviewed was 60, and the total number of staff was 28 working in different positions (chef of the healthcare centres, doctors, receptionists and nurses).

The perceived affective qualities from the interviewees were analyzed by Correspondence Analysis (CA), which can be seen as a generalization of principal component analysis when the variables to be analyzed are categorical instead of quantitative (Abdi and Valentin, 2007). Correspondence Analysis is a technique that represents graphically the row and column categories and allows for a comparison of their "correspondences", or associations, at a category level (Beh, 2004).

The classification of collected design attributes, based on two studies (Leather et al, 2003; Bitner, 1992), was by categories of Functionality, *Facility, Interior Appearance and Activity*. In order to investigate the second research question, the relation between design elements and feelings responses were analyzed by Rough Sets Method (Pawlak, 1982).

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Table 2: Overview of the data collection and analysis approaches

Data Collection		Analysis	
Subjects	Type	Fieldwork	Experiment
Patient			$-\tilde{}\ \chi^2$ Independency Tests
	Interviews	-Data linking	- Correspondence Analysis
Personnel	(Text:	-Content	-Rough Sets Analysis
	open end)	analysis	

Results

The results of the exploratory study on identifying Kansei values showed that three different quality dimensions interact with each other as important in feeling a waiting room's Affective Qualities, Technical Quality and Interaction Quality (Figure 4). These qualities were desired from patients and staff for the servicescape design. When these qualities interact with human's cognitive state based on personal characteristics such as experience, knowledge this interaction constructs the basis for the individual's Kansei.
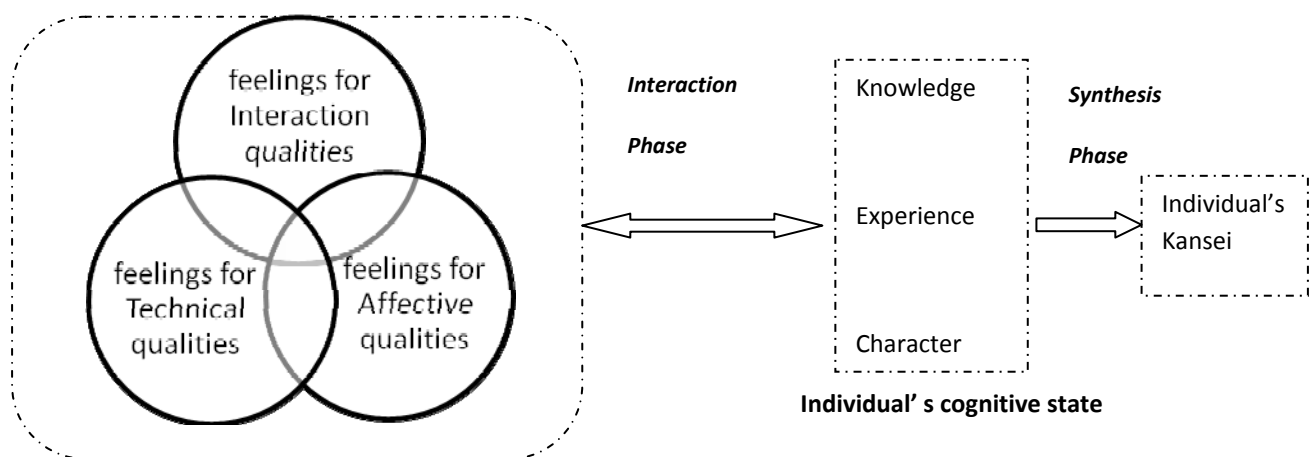
Figure 4. Kansei feeling space for a healthcare servicescape.

5. Conclusions

It is suggested in this study that interactions between designs attributes need to be considered to understand and reflect human feelings in servicescape design. With the case study it has been shown that Affective Engineering can provide methodological solutions towards understanding affective needs and values towards products responding to customer's needs.

More structured data collection methods are needed to understand customer's affective needs. With the approaches presented here the author wants to point out the needs for methodological developments to distinguish between functional and affective values for a service environment and to show how the two dimensions of values interact for future improvements.

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Human nature has a complex and dynamic structure and due to this designing and developing products that will satisfy desires, wants and needs are usually difficult. This dynamic structure has been modelled in the present study by showing the interactions between human Kansei and between Kansei and product design attributes. In the broad level of environmental design taking positive-negative interactions both for feelings and physical design attributes into account is inevitable.

The framework proposed in this paper may be developed further in order to better handle studies of complex contexts and environments with extremely many design alternatives. It is argued that by distinguishing important feelings from intangible and tangible quality characteristics generating Kansei values, waiting experiences can be designed that connect with people on a deeper level transforming the environment into spaces of greater significance.

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The role and design of the service environment in creating favourable customer experiences

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Abstract

Purpose – The important role of the environment in service experiences is well established and accounted for in the marketing literature. Several theoretical frameworks and concepts have been suggested such as the servicescape. So far, the empirical studies have mainly focused on the effects of single variables, like music, scent or signage. Consequently, further empirical and conceptual research is needed with a holistic view. This paper contributes to this knowledge gap by building on a recent conceptualization of the experience room model. The aim of the study is to further explore design dimensions of an experience room. We examine the role of the experience room dimensions in the processes that result in the co-creation of value-in-use, while investigating their relative importance.
Methodology/approach – Contrary to current research in this field the context of this paper is a day-to-day continuous service, a journey using public transport. In line with the explorative character of the research aim, the study uses a qualitative approach. A special form of focus group interviews were conducted with the 24 travellers. The aim of the focus group discussion was to create an experience map consisting of design dimensions, which were subsequently specified with particular characteristics. The characteristics were categorised by the respondents into the different dimensions. In a second phase, these characteristics are rated according to their importance by the respondents.
Findings – Reliability, price and the schedule were the most important characteristics for the respondents, which were categorised by the respondents into different design dimensions. In the public transport context the dimensions Intangible artefacts and Technology seem to be of special importance.
Research limitation/implication – The study underlines that the customer perceives the environment holistically suggesting that the different dimensions of the environment are interdependent as perceived by customers.
Originality/value – The study contributes by providing a further development and deeper understanding of design dimensions available to service providers in order to design the service environment and the experience room supporting favourable customer experiences.
Keywords – Service experience, experience room, design dimensions, experience map
Type – Research paper

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Introduction

In order to create a competitive advantage and to make a profit, companies are exploring new and better ways to differentiate their market offerings (Prahalad and Ramaswamy, 2004a; Shaw and Ivens, 2002). One such opportunity for differentiation is creating favourable prerequisites for the customer experience through the design of the service environment the company is providing. According to Ezeh and Harris (2007) however, this resource is widely unemployed. Due to our knowledge of the importance of the service environment (Bitner, 1992) this seems rather surprising. So why do companies not use this resource better? It could be argued that the answer lies in the current state of academic knowledge. What we know so far from several empirical studies is that different variables, like music (Dubé and Morin, 2001; Morin *et al.*, 2007), scent (Orth and Bourrain, 2005; Zemke and Shoemaker, 2007), or lighting (Baker *et al.*, 1992; Summers and Hebert, 2001), can influence the service experience. As a result of several empirical research projects in the retail industry (Turley and Milliman, 2000) we also know more about specific characteristics of how to design such environments and which of them are of greater importance in this context. Yet, we still lack knowledge about specific design dimensions and their relative importance in different service contexts.

The aim of this article is to contribute to the knowledge gap by answering the following research questions:
1. How can design dimensions for service environments be specified in a specific context?
2. Which relative importance do various dimensions of the environment have on the customer experience?

We apply a recent model of design dimensions for an experience room (Edvardsson *et al.*, 2005a) and aim at ensuring a customer perspective in order to be able to give recommendations to companies.

This article analyses the first part of two empirical studies in the public transport context and starts with a description of the theoretical framework for this work, in particular the experience room model. Subsequently our methodology for reaching our aim is described. After having presented the results of our empirical study we will focus the discussion on what this paper adds to the existing knowledge on service environment and finish with some managerial implications.

Theoretical framework

In order to attract and retain profitable customers, companies are exploring reconfigurations of roles and relationships among different actors (e.g. customers, suppliers, employees) to differentiate their market offerings (Bendapudi and Leone, 2003; Normann and Ramirez, 1993) and form the basis for favourable customer experiences (Edvardsson et al., 2008). This has been argued to be caused by the traditional value propositions not being able to achieve significant differentiation any longer. Being successful in this quest demands a focus on customers' experiences (Carbone, 1998). It is often these experiences that make the difference between high and low performing companies instead of just a cognitive assessment of the service (Johnston and Clark, 2001). That is, apart from functional qualities, emotional

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responses are part of customers' experiences which need to be attended to by companies (Edvardsson, 2005). This is in line with empirical findings on satisfaction responses of consumption experiences, consisting of both, cognitive as well as affective dimensions (Mano and Oliver, 1993). While emphasizing value co-creation Prahalad and Ramaswamy (2004a, p. 10) similarly make the case for experiences by postulating that "the opportunities for value creation are enhanced significantly for firms that embrace the concepts of personalized co-creation experiences as the source of unique value". Conformingly, Lusch et al. (2007) state that value co-creation, "value-in-use", and customer experience are related concepts, implying a relational perspective. A more concise account is presented by Holbrook (2006, p. 212), who defines customer value as an "interactive relativistic preference experience". The interactive part describes the interaction between an object and a subject, that is, any kind of good, service, or other offering and any kind of customer, private or business. Customer value is relativistic in several ways, comparative, situational and personal; comparative as in comparing two objects with each other; situational as in varying from one context to another; personal as in varying from one individual to the next. The preference part depicts preference judgements, which, depending on the specific viewpoint, has been termed in different ways, such as attitude, affect, satisfaction, or behavioural tendency. Their common denominator is the investigation of ways in which one object is preferred to another. The experience part acknowledges that value is not embedded in an object or the possession of one, but resides in a consumption experience. According to Li et al. (2001) experiences can emerge directly, indirectly and virtually, but always stem conceptually from the interaction between an object or an environment and an individual.

The interaction or relation between customer and environment has been described in many different ways in marketing literature. As early as in the mid 1970ies, Kotler (1974) highlighted the importance and postulated atmospherics to be an important tool in marketing. Atmospherics depicted to be the deliberate design of space in order to influence buyers' emotions in a positive way to increase the likelihood of a purchase. This is achieved through the design of four sensory dimensions, being sight, sound, scent, and touch. It is highlighted that a division between intended and perceived atmosphere exists. Next to providing a new typology for service organizations, Bitner (1992) provided the new term and conceptual framework servicescape. The framework describes how the physical environment affects employees as well as consumers in service organizations. Configurations of three different environmental dimensions, ambient condition (e.g. temperature, music), spatial layout and functionality (e.g. layout, furnishings), and signs, symbols and artefacts (signage, style of decor) are postulated to create a holistically perceived servicescape that activates internal cognitive, emotional and physiological responses with customers and employees. These are moderated by personality traits and situational factors. The internal responses affect subsequently behaviour of the actors in terms of approach (affiliation, exploration, staying longer) or avoidance (opposite of approach) and the social interactions between the actors.

A limitation of the two models is their focus on the physical environment only (Edvardsson *et al.*, 2005a; Rosenbaum, 2005) and the exclusion of social and emotional elements, which can affect the service experience to the better or worse (Grove and Fisk, 1997). Of late, Tombs and McColl-Kennedy (2003) suggest a social-servicescape model, accounting for this theoretical gap. All three models build on the stimulus-organism-behaviour concept stemming from environmental psychology (Mehrabian and Russell, 1974). In this concept, the customer is regarded as a passive element, which is affected by and responds to the environment. This passive view of the customer received criticism (Aubert-Gamet, 1997) and is not in line with current thinking within marketing suggesting a new service logic (Vargo and Lusch, 2004), in

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which the customer is a important resource and an active co-creator of service and the resulting service experience. Bonnin (2006) suggests the concept of appropriation in order to increase our understanding of the service environment and calls for further research, especially to gain more knowledge about the interaction process between service environment and service experience. Yet a different model is suggested by Edvardsson et al. (2005a). The authors develop the notion of the "experience room", a place allowing simulated service experiences. Five design dimensions are argued to constitute the experience room, including (a) physical artefacts, (b) intangible artefacts, (c) technology, (d) customer placement, and (e) customer involvement. In a later development of the model Edvardsson et al. (2008) include a sixth dimension (f) interaction with employess. In the following, the dimensions shall be shortly explained (this section is based on Edvardsson *et al.*, 2008).

Physical artefacts
Physical artefacts (P) represent the physical signs, symbols, products, and the infrastructure necessary to create the physical attributes of the experience room (cf. Bitner, 1992; Rafaeli and Vilnai-Yavetz, 2004).

Intangible artefacts
Intangible artefacts (I) incorporate the non-physical infrastructure and might include mental images, brand reputation, narratives, norms and values (Normann, 2001; cf. Edvardsson and Enquist, 2002).

Technology
Technology (T) stands for the nature and role of the equipment that customers interact with, either positively or passively (cf. Venkatesh, 1999) and is consequently not limited to information and communication technology (ICT). It includes as well how service processes are carried out (Edvardsson *et al.*, 2005a).

Customer placement
Customer placement (CP) refers to where the customer is placed and 'staged' in the experience room (Sherry, 1995) and is a prerequisite for interaction with others as well as products.

Customer involvement
Customer involvement (CI) represents the role(s) taken and enacted by the customer(s) in the experience room (cf. Prahalad and Ramaswamy, 2004b; Swaminathan and Zinkhan, 1996).

Interaction with employees
Interaction with employees (IWE) describes the ways in which customer contact with the service provider is present (cf. Bowen, 1990).

We argue that this model holds some key advantages. First of all, the focus is not on the physical surroundings, these are merely one part of it. Second of all, social interactions are an integral part of the model, which play an important role in the service environment.

Based on the dimensions of the experience room above, we will study how service organizations can go about designing experience rooms for their customers. The purpose of the paper is to explore characteristics in the dimensions from the customer perspective and assess the relative importance of the design dimensions and their characteristics respectively.

The empirical context

As empirical context, we chose public transport. A well functioning and generally accepted public transport system is often regarded as absolutely necessary in order to reduce the negative affects of private car use and to achieve sustainable development in today's society (Gärling and Steg, 2007). Surprisingly, little research is conducted to investigate the customers' perception of the provided service (Friman *et al.*, 2001). Obviously, this calls for further research and requires a deeper understanding of the public transport services, which seems necessary in order to achieve a higher market share. Similar to other service contexts, the role of the service environment is very important in public transport, as it is here, where the service is actually experienced by the customer. But not only could the actual carrier be regarded as a servicescape. Train and bus stations alike with their many signs, time tables and layouts represent fruitful research contexts. As was highlighted above, other customers have an impact on the service experience as well. This can be argued to be especially the case in public transport, which is a public place, shared with many other customers of different socio-economic backgrounds.

Methodology

Twenty six domestic as well as international students recruited at the University of Karlstad each conducted four trips using Public Transport during a given week in 2007. The students were provided with a transport diary and instructed to keep as detailed notes as possible about their service experience in order to ensure the customers' definition and views are captured with the customers own words (Echeverri, 2005).

Based on the narratives from the 26 students and their service experiences during the four trips, we conducted three focus group interviews with a total of 24 students. We now focused on the most important environmental dimensions as defined and assessed by the respondents in the focus groups. The method used is a special form of focus group, in which the participants interpret their responses themselves, as described by Björlin and Edvardsson (2003). Each focus group session commenced with a presentation of the aim of the study and the question in focus was introduced; what is important for *you* when using public transport? The aim of the focus group discussion is to create an experience map which is consisting of first the design *dimensions* of the service environment e.g. the physical technical resources or the technology used. The customer defined dimensions are described in detailed in the form of *characteristics*. This is the first part of the map which is the description expressing the voice of the customers. The second part of the map consists of two main parts; the selection and ranking of the three most important characteristics which is carried out individually by the respondents as is the case with the fourth phase which is giving marks to the different characteristics. This is also done by the respondents individually. Finally the group is asked to suggest three areas to improve the design of the service environment to arrive at a more favourable customer experience of the service focused on. This method is a combination of quality function deployment and phenomenographics (Edvardsson, 2002; Björlin and Edvardsson, 2003).

Design dimensions of the experience room in a public transport context

The importance of the service environment is often highlighted in the marketing literature (Ezeh and Harris, 2007). Too often though, the focus is here on the physical environment, often associated with the term servicescape defined by Bitner (1992, p. 65) as the "objective physical factors that can be controlled by the firm to enhance (or constrain) employee and

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customer actions". As our research highlights, when listening to the voice of the customer however, the focus is much broader. In the following the characteristics of the initially presented design dimensions shall be presented (see also table I). Note that some characteristics occur in several dimensions. This can be due to mainly two reasons. The first could be due to the fact that customers perceive the service environment holistically and consequently have problems with categorizing one characteristic into a specific dimension (Mattila and Wirtz, 2001). The second could be that the respondents interpreted the dimensions differently.

The three most important characteristics were "doing as promised", price, and "schedule". The most important characteristic according to the respondents views in the focus group interviews and described and assessed in the maps are that the service provider is fulfilling its promises, that is, leaving and arriving on time, stopping at the bus stops, as advertised. A good price was rated by the participants as the second most important characteristic, followed by a schedule that fits the customers' needs, that is, the possibility to reach all destinations with public transport, with high frequencies. Safety was rated as the fourth most important characteristic, but scored almost only half the points as the third most important characteristic. Competent staff with proper driving behaviour and language skills was regarded as the fifth most important, scoring on similar levels as the safety characteristic. Rated by a fraction of the most important characteristics, the least two important characteristics rated by more than one person are easy to use and time needed for the trip.

Table I - Characteristics of design dimensions and their importance

Characteristics	Importance
On time/Reliable/Do as promised (T,T,I,I)	9+14+11+3=37
Price (T,I,I)	11+11+13=35
Schedule (T,CI,T)	4+6+23=33
Safety (I,CP,P)	9+5+3=17
Competent staff (driving behaviour, language) (I,IWE)	11+5=16
Easy to use (T)	5=5
Time needed (T)	4=4

Table II provides and overview of the design dimensions and the characteristics specified by the participants.

Physical artefact
Physical artefacts are, among others, the necessary physical infrastructure for the service experience (Edvardsson *et al.*, 2005a). Within this dimension, "safe vehicles" was the only characteristic rated as important for customers in the public transport context.

Intangible artefacts
Intangible artefacts provide the non-physical infrastructure and assist customers to envision how products and/or services are able to create value and positive experiences (Edvardsson *et al.*, 2005a). Here, the two most important characteristics mentioned by the respondents are the price as well as "do as promised" in a sense that the departure and arrival takes place on time and as advertised in the schedule. Safety, described as the "general feeling of being safe during the trip" and competent staff in regards to driving behaviour and language skills are other important characteristics in this dimension.

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Technology

Technology is to be understood in a broad sense including information and communication technology (ICT) as well as how the intended service processes are to be carried out to "infer quality through meaning, arousal, and excitement" (Edvardsson *et al.*, 2005a, p. 153). Due to the broad definition and the importance of the service processes (Lovelock and Wirtz, 2006) it is not surprising that most characteristics named by the respondents were codified to this dimension. "Schedule and lines fit my needs" is here the most important characteristic followed by price. "Punctuality" and being "on time" were rated as third most important in this dimension, followed by easy to use and "time needed" for the trip.

Customer placement

Within the dimension customer placement, that is where the customer is placed and 'staged' in the experience room (Sherry, 1995), the participants codified "security on the bus and train".

Customer involvement represents the role(s) taken and enacted by the customer(s) in the experience room (cf. Prahalad and Ramaswamy, 2004b; Swaminathan and Zinkhan, 1996) and includes only one characteristic rated as important, namely departure and arrival times fit my schedule.

Interaction with employees

Interaction with employees describes the ways in which customer contact with the service provider is present (cf. Bowen, 1990). Here the participants coded competent staff with good language skills and driving behaviour.

Table II - Design dimensions and their characteristics in a public transport context

Dimensions	Characteristics	Importance
Physical artefacts	safe vehicles	3
Intangible artefacts	reliable/do as promised	23
	good price	11
	Safety	9
	driving behaviour	5
Technology	schedule and lines fit my needs/timetable	27
	Price	24
	punctuality/on time	14
	easy to use	5
	time needed	4
Customer placement	security on the bus and train	5
Customer involvement	departure and arrival times fit my schedule	6
Interaction with employees	competent staff (language skills/good driving behaviour)	11

In summary, the dimensions Intangible artefacts and Technology were rated most important by far with most characteristics specified by the respondents.

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Discussion

The aim of this paper is to contribute to a deeper understanding of the role of the service environment for a favourable customer experience. Previous research has not included social, and emotional dimensions of the environment but more narrowly focused on dimensions of the physical environment only. Two research questions have directed this study: (1) How can design dimensions for service environments be specified in a specific context? (2) Which relative importance do various dimensions of the environment have on the customer experience? Our point of departure is a previously suggested framework focusing on six design dimensions of the experience room (Edvardsson et al., 2005a; 2008). In this study we test the relevance of the suggested design dimensions in a new context; public transport service and especially explore if new dimensions should be included or not.

Our empirical findings suggest that the six dimensions capture the range of characteristics that should be paid attention to when design experience rooms also in public transportation service settings. When comparing the results in this study with the results in previous studies in four very different service contexts (Edvardsson et al., 2005a; 2008): (1) retailing (IKEA), (2) buying a new house, (3) deciding on a MBA program (the open day at Warwick Business School in England) and (4) a website for a research conference (QMOD) we find that the overall design dimensions are useful but the characteristics are service environment specific. Thus, the design dimensions are not enough to design the environment in a favourable way. The dimensions are at a too high level of abstraction and need to be contextualized.

In the public transport context, we have found that the physical artefacts (e.g. the bus itself) have been rated by the participants less important than maybe expected. This underlines the importance of the social dimensions (Tombs and McColl-Kenndey, 2003) as well as the experiential character of a service (Holbrook, 2006). When reminding us of the definition of services as activities, deeds or processes, and interactions (Edvardsson *et al.*, 2005b) the lower importance of the physical artefacts do not seem too surprisingly. Consequently, not the design of the design dimensions should be the main focus in service environment development, but rather the interaction processes between customer and environment. This is in line with the active role of the customer as co-producer (Kalaignanam and Varadarajan, 2006).

In this study we have learnt that the customer perceive the environment holistically suggesting that the different dimensions of the environment are interdependent as perceived by customers when it comes to forming the prerequisites for the customer experience. Thus, we can not understand how to design the environment by focusing on individual design dimensions only but focus on the drivers of the total customer experience also and the relative importance of the various service specific environmental characteristics. The findings in this study suggest that the interplay between different dimensions is important, as they may convey the same message, e.g. safety is expressed through not only the vehicles as such but also in the way the driver is handling and driving the bus.

The results in this study contribute to the emerging conceptualization of the service-dominant logic (SDL) of marketing (Vargo and Lusch 2004; 2008). SDL is based on a resource advantage perspective combining *operand resources* (linked to physical resources) and *operant resources* (linked to people, both customers and employees). Goods, services and information and combinations of these enable and facilitate the customers own value creation. Value is not embedded in the resources e.g. services but value is rather created and realized

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by the customer and assessed on the basis of value in use in the customers' own context. SDL does not explicitly pay attention to the dimensions and resources in the service environment, the relative importance of these resources and how the resources are perceived, used and assessed by customers and their role in forming customer experiences of service.

The results of our study that characteristics are belonging to different dimensions from the customer perspective, lead as well to methodological consequences. First of all, having the same characteristics in different dimensions can be regarded as a break with traditional coding and formation of dimensions. In the method used in this study, the participants themselves coded the characteristics into the dimensions. Consequently, reducing misinterpretations that at times occur in traditional focus group research (Krueger, 1998). Second of all, criticism of *a piori* models used in questionnaires (Silverman, 2007) often used in servicescape research can be supported. This holds true as well as for context unspecified, generic instruments like SERVQUAL (Parasuraman *et al.*, 1988), arguing for more qualitative research designs or at least contextual adaptations of measurement instruments.

Managerial Implications

Three managerial implications will be discussed here. First, the results in this study show that five characteristics are most important: (1) On time/Reliable, (2) Price, (3) Schedule, (4) Safety and (5) Competent staff in the frontline. Characteristics 1-3 are the most important ones according to the customers in the focus groups. The design of the environment should focus on these areas and investing in these should be more profitable than in other areas such as physical artefacts. This is in line with the service logic suggesting that services, also public transport services, come about and are assessed in use on the basis of activities and interactions perceived by customers. Second, different design dimensions of the experience room or service environment contribute to the same characteristic or component of the customers' experience. One example is safety where the physical resources e.g. the bus together with the interaction with front line staff and the way the bus is handled by the driver. Thus to focus on individual design dimensions only is not enough since the customer experience is a gestalt, customers experience the service as both prerequisites, processes and outcomes holistically. The implication of this is that customers should be integrated or involved in designing the service environment and experience room which is our third managerial implication.

Limitations and future research

The choice of students as respondents can be argued to be a limitation of our study. However, students as respondents are rather common in contemporary marketing research. Moreover, their knowledge concerning the model in focus was considered to be an advantage. Another limitation could be the amount of only three focus groups. Consequently, we are not aiming to make generalisations for all public transport customers or speak of representativeness in a statistical sense. Nevertheless are students an important customer segment in this context. Students have often no choice then to use public transport due to their economic situation. Satisfied student customers could ensure that they would continue to use public transport once their financial situation improves.

As mentioned above, this article is the first part of two empirical studies. In the next article, the public transport diary material will be included and analyzed and compared to the focus group results. Future research should continue this path of more *in situ* research, that is,

observational studies that make use of the diary method or videography for instance. This is in line with explicit calls for observational studies by Bitner (1992). Moreover, similarities and differences of the importance of design dimensions in different context could be examined.

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Values-based service for sustainable business
-Lessons from the retailers IKEA, Starbucks, H&M and Body Shop

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Abstract

Aim The aim of this paper is to explore the role of values-based service for sustainable business. The two basic questions addressed are: What is 'values-based service'? How can values create value for customers and other stakeholders?

Design/ methodology/ approach This paper is based on extensive empirical studies focusing on the role of values at the corporate, country and store levels in the retail company IKEA and a comparison of the results with data from Starbucks, H&M and Body Shop. The theoretical point of departure is a business model based on the service-dominant logic (SDL) on the one hand and control through values focusing on social and environmental values forming the basis for a sustainable business.

Findings Based on a comparative, inductive empirical analysis, five principles for a sustainable values-based service business were identified: (1) Strong company values drive customer value, (2) CSR as a strategy for sustainable service business, (3) Values-based service experience for co-creating value with customers, (4) Values-based service brand and communication for values resonance and (5) Values-based service leadership for living the values. A company built on an entrepreneurial business model often has the original entrepreneur's values and leadership style as a model for future generations of leaders. However, the challenge for subsequent leaders is to develop these values and communicate what they mean today.

Orginality/ value We suggest a new framework for managing values-based service to create a sustainable business based on *values resonance*.

Key Words: Values-based service, corporate values, foundation values, CSR, value-in-use, values resonance, sustainable service business, service experience, service brand and communication, service leadership.

Introduction

The notion of 'customer value' includes not only *economic value* but also value that is linked to *values*. From the customer's perspective, 'value' is an overall personal assessment of the quality attributes of the market offering in relation to the price and other sacrifices. It is a subjective assessment of the positive and negative consequences associated with the purchase, including values linked to the provider.

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Values can be understood as the principles, standards, ethics, and ideals that companies and people live by. A distinction can be made between two main categories of values: (i) a company's *core values* (which form the basis of the company culture); and (ii) *foundation values* (which reflect the norms of society in general). Compliance with the later category constitutes so-called 'corporate social responsibility' (CSR), which refers to a company's social and environmental responsibilities. A values-based business is thus based on a combination of core company values and foundation values, which guide the company in creating customer value and a sustainable service business. Such values are crucially important in creating customer value and forming the basis for a sustainable service business.

Mainstream business is today product and production oriented and thus characterized by a 'goods-dominant logic' (GDL), which can be seen as the opposite of a 'service-dominant logic' (SDL) (Vargo and Lusch 2004, 2008). The main focus of the SDL paradigm is that value is co-created with customers and assessed on the basis of 'value in use'. Market offerings are understood as being resources that produce effects. Despite the growing awareness of SDL, the focus in service-management research has continued to be on the structural processes of the service system.

The notion that a service culture, grounded in company core values and CSR, drives service strategy has not been empirically examined in any great detail. This article is based on a three years research journey resulting in the book *Values-based service for sustainable business – lessons from IKEA* (Edvardsson and Enquist, 2008) focuses on what might be called 'values-based service', with particular emphasis on the role of such service in the furniture company, IKEA. 'Values-based service' is, in this article, defined as service that is firmly based on the core company values as well as social and environmental responsibility. When the core company values, the social and environmental values are in accordance with the values of customers and other stakeholders, resonance (rather than dissonance) occurs. To be successful, a values-based service business must seek resonance with their customers and other stakeholders in terms of values, and avoid any suggestion of dissonance. We use insights from IKEA, together with a conceptual analysis based on SDL to create a framework of values-based service for sustainable business. The framework guide the empirical study in IKEA and the results are compared with data from Starbucks, H&M and Body Shop.

This article is the first on the role of values in developing and managing a *sustainable* service business. The focus is on the role of values in creating customer and stakeholder value and thus co-creating a sustainable business. The two basic questions addressed are: (1) What is 'values-based service'? (2) How can values create value for customers and other stakeholders?

The article is structured as follows: First, we present our theoretical framework for studying a values-based sustainable service business. Second, research design followed by the lessons from IKEA, a comparison with data from three other retailers and finally five principles and a model for a successful values-based service business is presented.

A theoretical framework for studying a values-based sustainable service business
Figure 1 presents our theoretical framework for studying a sustainable service business. We use a matrix of two value-creation logics (service-dominant logic and goods-dominant logic) on the vertical axis and two business models (a control-based business model and a values-based business model) on the horizontal axis. The term 'control-based business model' refers to a short-term focus on financial results, whereas the 'values-based business model' shifts the

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focus from a short-term preoccupation with financial matters to incorporate long-term, values-driven governance principles and key performance indicators. In such a 'values-based business model', the core company values, foundation values (that is, the company's social and environmental responsibilities), and customer values drive the financial and other business goals (such as growth, customer satisfaction, and risk). By combining a service-dominant logic with a values-based business model we position IKEA, our main case in this paper in the upper-right section of the matrix shown in Figure1.
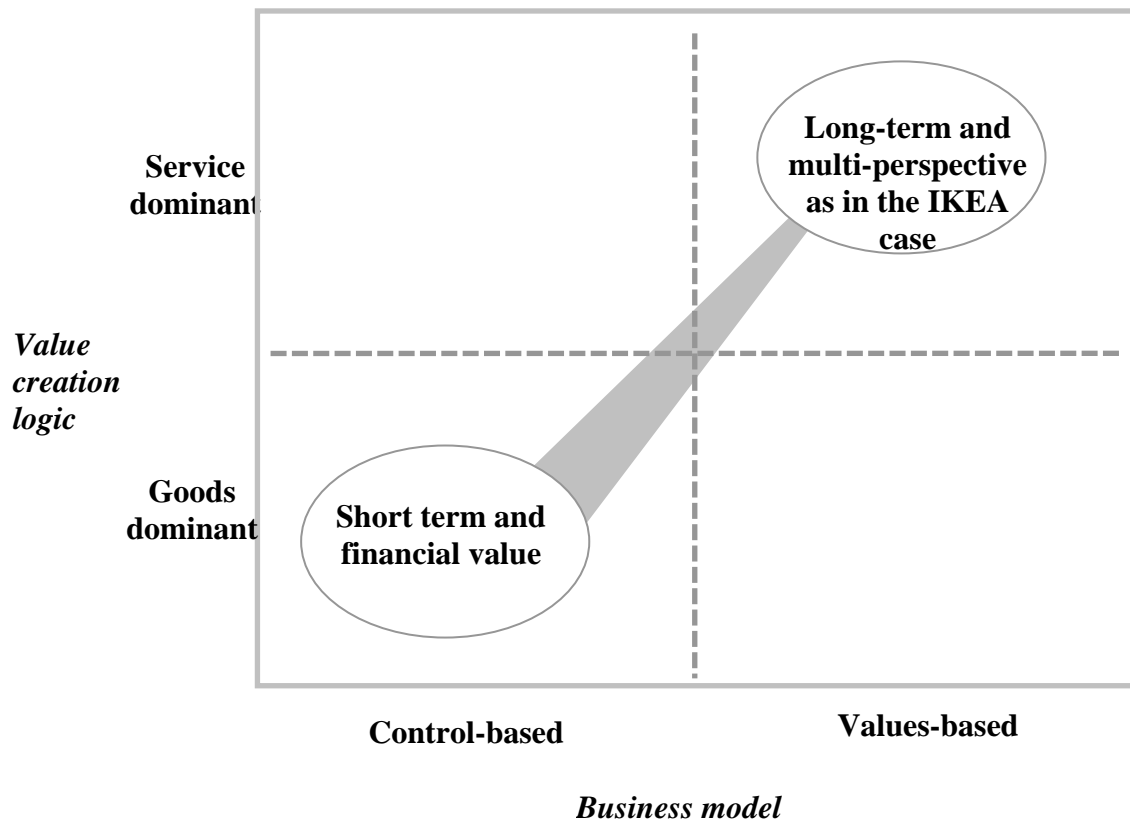
Figure 1. A framework for studying a values-based, sustainable service business.

To study values-based service for sustainable business in a practical business situation, it was important to choose a service company that has been successful in terms of growth and profitability. We selected IKEA. Some might argue that IKEA is a product retailer and not a service company; however, IKEA views itself as a service provider—because the company's focus is not on the furniture itself but on 'solutions to real-life problems' and making a contribution to a 'better life' for the majority of people. This is clearly a service concept in which the physical products are perceived as platforms for service experiences that create customer value. Moreover, IKEA is a service-oriented company in the sense that the passion is on *serving* people with well-designed, quality products at a price they can afford.

IKEA is a successful, profitable company and the global leader in its industry. The firm is known for a strong service culture that emphasises company core values and a strong sense of corporate and social responsibility. IKEA has demonstrated an ability to serve customers and

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renew its business at a time when many other companies have been more focused on narrow conceptions of shareholder value and internal issues. Other companies and organisations can learn from IKEA, and it is the aim of this paper to provide inspiration and practical guidance in analysing an organisation's values as a basis for a sustainable service business. In short, this paper contributes to a better understanding of the strategic role of values in forming and directing service strategy and value-in-use for customers. The values of a company guide the attitudes and behaviours of the firm's leaders, employees, and customers, as well as determining the business strategy and vision of the company. In the context of IKEA, such values (in the sense of 'ideals') are crucial for understanding customer value and value-in-use.

According to Palmisano (2006), businesses are changing in fundamental ways—*structurally*, *operationally*, and *culturally*—in response to globalization and new technology; as a result, the larger companies are no longer 'multinational corporations' (MNCs), but *globally integrated enterprises*. He also suggests 'global collaboration', whereby various stakeholders interact in development and learning processes. IKEA is an example of a 'globally integrated enterprise' in which economic, environmental, and social perspectives are integrated in support of one another. The supply chain of IKEA has its roots in the Swedish county of Småland, which is a region of limited resources, and this represented a significant challenge for the management of IKEA in its entrepreneurial efforts to create smart solutions (Edvardsson and Enquist, 2002).

Research design
We have been studying the development of the Swedish furniture retailer, IKEA, for several years. This has involved: (i) the extensive perusal of documents; (ii) multiple interviews with IKEA managers; (iii) the collection of narratives about IKEA from the media, the Internet, books and from internal material from IKEA; (iv) personal observations at IKEA stores and service centers in Europe, Asia, and North America; and (v) supervision of 15 masters' theses and field reports on related subjects. Our research has resulted in a number of articles including Edvardsson and Enquist (2002); Edvardsson, Enquist and Johnston (2005); Edvardsson, Gustafsson and Enquist (2005); Edvardsson, Enquist and Hay (2006); Enquist, Edvardsson, Petros Sebhatu (2007). The comparative study of Starbucks, H&M and Body Shop have been done in parallel with the IKEA study during 2006 and 2007 and resulting in two written papers Enquist, B., Edvardsson, B. and Petros Sebhatu, S. (2007b) Enquist, B., Edvardsson, B. and Petros Sebhatu, S. (2007c) and parallel with this process the book Edvardsson and Enquist (2008) has been developed during 2007 and 2008.

Lessons from IKEA
The lessons to be learnt from the study of IKEA (Edvardsson and Enquist, 2008) can be summarised in five areas as follows: (i) a new entrepreneurial business model; (ii) the logic of values and the logic of value creation; (iii) service experience; (iv) service brand and marketing communication; and (v) service leadership.

<u>A new entrepreneurial business model</u>

IKEA began in a poor farm village in the southern Swedish county of Småland. The entrepreneur, Ingvar Kamprad, challenged established views from the beginning. For example, he believed that an entrepreneur should first make money before spending or investing; he disliked being dependent on loans from a bank.

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IKEA's original focus was on furniture that had 'function', 'quality', and 'low price', and these attributes (together with the later addition of 'good design') remain the core components of the business model that is firmly embedded in the IKEA culture. The original supply chain and business model of IKEA had to cope with the limited resources that existed in the relatively poor district of Småland, but this lack of resources had the virtue of stimulating the creation of 'smart' solutions. In summing-up his entrepreneurial vision, Kamprad observed: "The question is whether, as an entrepreneur, I [could] combine the good in a profit-making business with a lasting human social vision. I like to think that it must be possible."

In focusing on smart solutions, Kamprad created the concept of furniture that customers could put together themselves. This resulted in lower warehouse and distribution costs, but it did require new ways of producing the products and new packaging (with instructions to the customers on how to assemble it). In effect, the customers became 'co-producers' of the IKEA solutions as some of the activities were transferred to the customers. This is the core of the IKEA business model, which has been further developed by a sophisticated supply chain and a systematic renewal of products and service offerings.

In addition, the marketing activities of IKEA, which used creative themes and emphasised the development of the IKEA brand, challenged established views of marketing in the industry. Moreover, the business model now also includes the establishment of new stores and the requisite transfer of IKEA knowledge and values from established markets to new markets in a variety of national cultures.

The culture in IKEA is based on shared values and meanings. The IKEA values are: (i) togetherness and enthusiasm; (ii) constant desire for renewal; (iii) cost consciousness; (iv) willingness to accept and delegate responsibility; (v) humbleness and willpower; (vi) simplicity; (vii) leadership by example; (viii) daring to be different; (ix) striving to meet reality; (x) constantly being 'on the way'; and (xi) being unafraid of making mistakes (with the privilege of making mistakes and putting them right afterwards). These values drive the company's strategy and provide guidance to leaders and co-workers alike. The values thus provide motivation to maximise the commercial potential of the company at all levels. The underlying theme is a customer focus (as IKEA puts it, 'to stand by the many'), combined with social and environmental responsibility. The focus is on solutions to real-life problems at home for the majority of people.

IKEA emphasises corporate social responsibility (CSR). IKEA's long-term strategy is to create a better life for all stakeholders. In this regard, social and environmental responsibility is a natural part of the IKEA business model. According to IKEA, social and environmental responsibility is profitable in the long run and is in accordance with IKEA's commitment to being cost-conscious.

Apart from the values held by its leaders and co-workers, the IKEA service strategy is driven by external pressure from customers, non-government organisations (NGOs), and competitors. The success of IKEA is based on the conviction that values and meanings are co-created among all members of the IKEA stakeholder network in various market contexts.

The logic of values and the logic of value

According to the traditional view, value is defined and created in the value chain and incorporated into products during product development and production. In contrast, the emerging

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view, as adopted by IKEA, is that value is co-created with customers and assessed on the basis of value-in-use during consumption experiences. In adopting this view, IKEA promotes its furniture and other products as 'enablers' of smart solutions to real-life problems at home. These solutions are co-created with the customer and their value is primarily assessed when the products are used. Value is thus predominantly assessed in terms of value in use.

This conception of the logic of value (whereby customers assess quality in terms of how design and function provide solutions to problems) is combined at IKEA with logic of values (whereby special attention is paid to the ethical, social, and environmental values that are increasingly playing a prominent role in customers' decisions to buy). Consumers have an increasing awareness of environmental, social, and ethical issues, which has resulted in corporate social responsibility (CSR) becoming a driving force in business development. IKEA's commitment to CSR is part of its wider commitment to its various stakeholders (including customers. co-workers, and suppliers). The social and environmental policies of IKEA are rooted in the core values of the company.

Service experience

Apart from value in use after the purchase, IKEA also creates value for its customers through the co-creation of individualized solutions during pre-purchase service experiences. This simultaneously reduces risk for the customer and enhances customer imagination and interaction with the organization.

So called 'hyperreality' is also used to provide customers with a pre-purchase service experiences. Just as product-based organizations have traditionally allowed their customers to 'test drive' their products, service organizations are increasingly utilizing simulated or 'hyperreal' experiences to enable customers to experience potential service solutions before purchase. In the case of IKEA, the firm enables customers to experience a new kitchen in the store and/or to use web-based experiences (such as the IKEA 'kitchen planner') to simulate or 'test-drive' various solutions.

An 'experience room' can support customers in their role as co-creators of value (make the solutions customized and 'tangible'), as well as facilitating the company's communication of its corporate values and. In this regard, the IKEA showrooms can be seen as 'experience rooms', in which customers receive a 'real' service experience before purchase.

Service brand and marketing communication

Three essential elements—vision, culture, and image—must be aligned if a values-based brand strategy is to be successful. In IKEA's marketing, value-in-use for customers is primarily of an instrumental nature, as communicated through the catalogue, the website, and the store showrooms. However, in IKEA's marketing strategy there is also communication beyond the instrumental level, whereby IKEA narrates a sustainable corporate 'story' in which vision, culture, and image complement one another in a successful branding strategy.

Taken together, IKEA's vision, business idea, and market positioning provide a framework for brand-building that is used in the entire firm's marketing communication worldwide. The brand embodies and expresses values that add value when customers experience solutions to real-life problems at home.

To ensure sustainable business success, a company needs to focus on a few basic values that are attractive to customers, employees, and other stakeholders. In particular, it is essential that the company's values and those of the customers achieve so-called 'values resonance'. The IKEA brand is built on associations with such values as cost-consciousness, design, unconventionality, and environmental awareness.

IKEA recognizes the importance of training, empowering, and rewarding leaders and co-workers to 'live the brand' in their interactions with one another, customers, suppliers, other partners, the media, and owners. 'Living the IKEA brand' is learnt by co-workers and leaders in their day-to-day work, in on-the-job training, and through educational programs that explain the IKEA way.

Service leadership

IKEA has created a strong culture built on authentic leadership and knowledge sharing. Most IKEA leaders are identified, developed, and promoted from within the organisation. Within the IKEA network, the values and skills of the organisation are cultivated by shared knowledge and authentic leadership. Leaders are promoted on the basis of their personal values, skills, potential, and what they have delivered so far. The sharing of IKEA values among leaders and co-workers ensures that values resonance within the firm provides energy and direction for sustainable business development.

IKEA trusts its leaders, co-workers, and customers, and emphasises the importance of their involvement. Trust is a pre-requisite for openness, creativity, and involvement. It is built from the top through authentic leadership, involvement, responsibility, and empowerment. In IKEA's view, when co-workers and leaders grow, the business is growing. In the IKEA network, reverse knowledge flows and lateral knowledge flows ensure that new smart solutions become a reality and have an influence on the global concept.

Comparison of IKEA, Starbucks, H&M, and Body Shop

A new entrepreneurial business model
All four companies were founded by energetic entrepreneurs: Kamprad at IKEA; Schultz at Starbucks; Persson at H&M, and Roddick at the Body Shop. All of these entrepreneurs have been innovative in their various consumer industries. They have built distinctive business models in their companies, and these have been retained and developed over decades through the dissemination of the entrepreneur's values throughout their organisations.

All four companies also have a business model for future success based on: (i) various forms of triple bottom line (TBL) thinking; (ii) attractive offerings in attractive stores; and (iii) strong supplier chains governed by social and environmental responsibility and the requirements of good citizenship. In addition, they have growth strategies based on investment in sustainable resources—IKEA in energy conservation and managing social and environmental responsibility; Starbucks in recycling and community development; H&M in environmentally friendly products; and the Body Shop in sustainable products. All four companies have strong corporate values and a clear focus on serving customers in a broad international target market.

The logic of values and the logic of value creation
In accordance with the logic of value creation, all four companies exert control over the design and development of the service offering and use suppliers in the value chain to control

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price, time, and quality. Moreover, in all four companies, the logic of value creation is driven by the logic of values. All take a TBL perspective with respect to logistics, stores, and production, and all have their own code of conduct to ensure that their social, environmental, and quality standards are maintained. They also attempt to engage their suppliers in positive empowering relationships that create value for the suppliers themselves.

Service experience
The studied retailers have a focus on serving customers and have developed management policies and systems with regard to the co-creation of value with customers. The IKEA policy promotes customer placement in store showrooms ('experience rooms'). For Starbucks, their customer-oriented policy is described as promotion of the 'Starbucks experience'. H&M promotes shopping as an easy and pleasant experience. The Body Shop aims for an enjoyable customer experience in their shops and at home. In all four cases, customer-oriented policies aim to promote favorable service experiences.

Service brand and marketing communication
Our case companies have well-known values-based global service brands. However, they do not explicitly use CSR in their market communication. All of these brands are positioned in accordance with the firm's views on environmental and social responsibility. The firms ensure that their brands are supported by the communities with whom they do business, that their suppliers are empowered, and that they engage with a range of environmental and social initiatives.

Service leadership
In all four companies, the knowledge and 'drive' of employees are of fundamental importance in developing a strong corporate culture with regard to 'living the brand' and sharing corporate values. Within IKEA, employees are referred to as 'co-workers'; Starbucks refers to 'partners'; H&M uses the term 'colleagues' and the Body Shop talks about 'our people'. All service leaders are expected to act as role models. Leadership performance is judged in terms of operational skills, cooperation with others, and sharing values and meanings. All four companies focus on investing in leadership performance and focus on the development of individual leaders and employees as a key strategy for company success. All firms are also seeking leaders from diverse backgrounds to create a multicultural employment environment reflecting the diversity among their present and potential customers. Gender equality in employment is also a goal of all companies.

Five principles for a sustainable values-based service business
From the comparative analysis presented above, five principles for a sustainable values-based service business have been developed.

Principle 1: Strong values drive customer value
Strong values form the basis for a company culture. In tandem with customers' values and the values of the wider society, strong corporate values provide energy and direction to business development. Innovative service businesses are often created by entrepreneurs who are imbued with a clear vision and a strong sense of mission. Such vision and mission are usually based on a firm set of personal values.

A company with strong values does not necessarily have unchanging values. Rather, values are dynamic, may be expressed in various ways over time and can become stronger in the sense that they become clearer, more relevant, and better integrated in the business model.

Such values are used by customers and other stakeholders when value is assessed. The values create bonds with customers and thus represent a significant loyalty driver. In summary, in developing a sustainable values-based company, values are pre-eminently important in the company's relationships with its staff, partners, suppliers, shareholders, and the media but most important its customers.

Principle 2: CSR as a strategy for sustainable service business
Sustainable values-based service businesses have a strong commitment to corporate social responsibility (CSR), which leads to quality-assurance systems, appropriate performance indicators, TBL thinking, and involvement with NGOs in control, assessments and improvement efforts.
A sense of social and environmental responsibility stimulates lean production, lean consumption, energy conservation, and the creative use of apparent 'waste'. Social and environmental responsibility thus contributes to profitability in a long-term perspective.

CSR is important for rethinking the role of any company in any industry. By using CSR in a proactive way, companies think 'laterally' in searching for 'smart' solutions. The logic of values thus drives the logic of value creation.

Principle 3: Values-based service experience for co-creating value
Many services are experience-based and companies should therefore create and offer 'test-drives' of services for customers to enable them to experience the service, before purchase and consumption.

Customers' experiences are formed during use or consumption of a service. When a customer's basic requirements are met, other issues make a difference. These issues are often subtle, affective, and values-based. A well-designed service concept should include an 'experience room' to make possible for customers to test-drive the service before purchase and use or consumption.

Principle 4: Values-based service brand and communication for values resonance
Brands are living expressions of what a company stands for. They communicate what its products or services can do for people. However, if a company overstates what its products can do, and subsequently fails to deliver (as perceived by customers), this creates adverse reactions—both in the market and among the company's employees.
Successful brands are not created *de novo*; rather, they develop naturally within value-based companies. These brands then enable values-based companies to reach out and connect with customers, staff, and other stakeholders.

Successful companies often challenge established views in suggesting something new and attractive in their marketing. These ideas can be provocative, but they must simultaneously resonate with the values of customers in the market. Values-based brands must incorporate values that are attractive to customers and avoid being associated with unfavourable values. Values resonance (both within the organisation and outside it) is essential for a sustainable values-based service company.

Using CSR to secure a values-based service brand is more than mere communication about CSR with the customers; rather, it is about using CSR as basis for strategy and ensuring that the service brand (and communication with all stakeholders) is in resonance with the company's values, the customers' values, and the values of the wider society.

Principle 5: Values-based service leadership for living the values

To secure sustainability, a values-based company needs a strong, values-based leadership. A company built on an entrepreneurial business model often has the original entrepreneur's values and leadership style as a model for future generations of leaders. However, the challenge for subsequent leaders is to develop these values and communicate what they mean today. To communicate these values in contemporary terms, it is essential that leaders 'live' the values. Leadership is about 'walking the talk'. Both the 'talk' and the 'walk' must make sense to employees and energise them to focus on serving customers, thus creating shareholder value. Leaders communicate through their interactions with employees, partners, suppliers, and customers. Authentic leaders therefore spend time with customers and employees and learn from them. Great leaders are directed not only by the logic of value, but also by the logic of values.

A model for values-based service businesses

It will be recalled that Figure 1 presented a matrix of two value-creation logics (service-dominant logic and goods-dominant logic) on the vertical axis and two business models (a control-based business model and a values-based business model) on the horizontal axis. It will be apparent that the four innovative service companies discussed above all base their value creation on the *service-dominant logic* and that their business models are *values based.* All four companies are therefore firmly situated in the upper-right quadrant of Figure1.
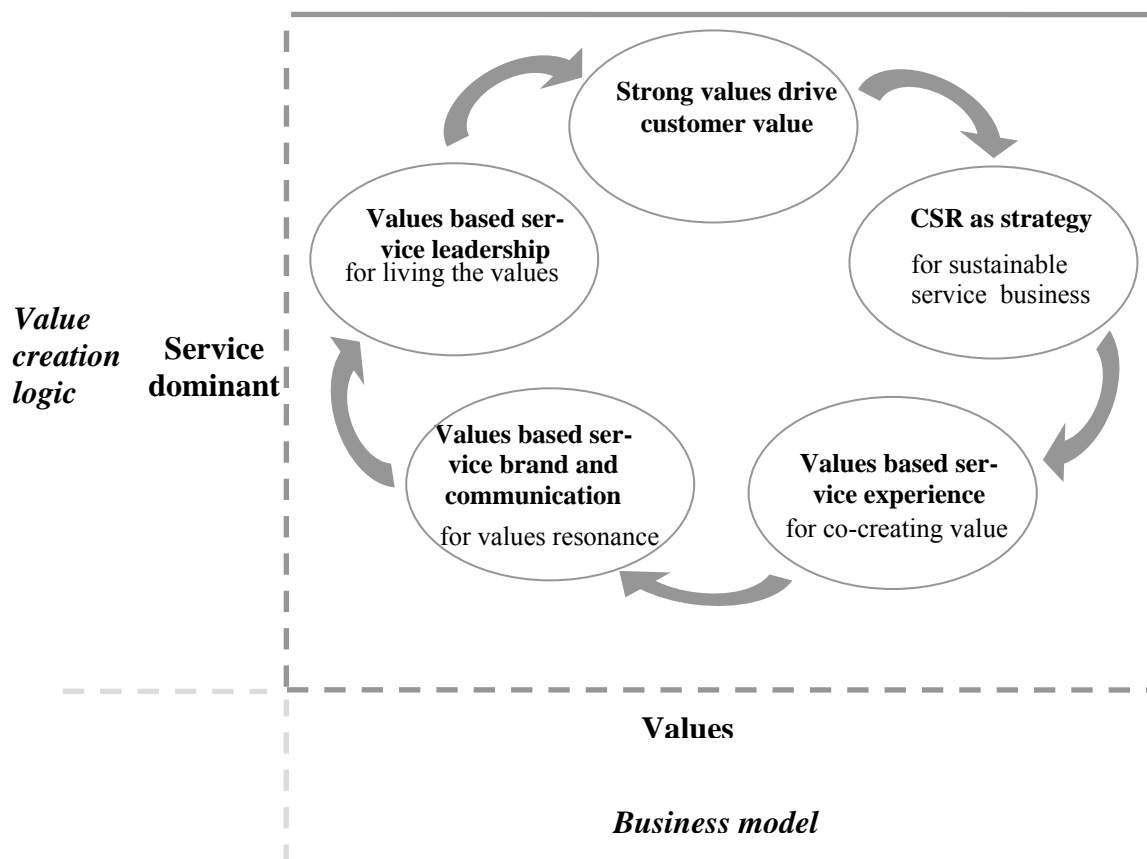
Figure 2. A model for values based service for sustainable business.

It is not suggested that these four companies are the only global businesses that would be situated in this quadrant. Many companies are now recognising the implications of sustainable

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development and the importance of values-based stances with respect to the environment and social responsibility. As Hart (2007, p. 3) has noted:

"Business—more than either government or civil society—is uniquely equipped at this point in history to lead us toward a sustainable world in the years ahead. I argue that corporations are the only entities in the world today with the technology, resources, capacity, and global reach required. Properly focused, the profit motive can accelerate (not inhibit) the transformation toward global sustainability, with nonprofits, governments, and multilateral agencies all playing crucial roles as collaborators and watchdogs."

Gore (quoted in Hart, 2007, p. xxiv) has expressed a similar view: "The interests of shareholders, both public and private, over time, will be best served by companies that maximize their financial performance by strategically managing their economic, social, environmental, and ethical performance."

All of the studied companies have well-developed processes for renewal and reconfiguration of their business models in the light of experience over time (Normann, 2001). Renewal is essential for sustainable success. The overriding orientation of the studied companies is a genuine focus on the customer and how to create value for customers. Superior customer value is based on favourable service experiences, a strong brand, and dynamic marketing communication. This requires staying close to the customers, understanding their requirements, and providing solutions that are in accordance with their values and lifestyles. Learning from (and with) customers in various ways is crucially important if a company wishes to remain customer focused.

Corporate social and environmental responsibility has been demonstrated to be profitable—both in the short term and in the long term. Innovative service concepts that utilise physical products as platforms for service and customer experiences can create value in use. The logic of values and the logic of value creation are synergistic, profitable, and sustainable.

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Values-based Service Innovations
– A Study in the Truck industry

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Introduction

In a service-driven economy, companies try to increase their competitiveness through service innovations that create value for existing customers, attract new customers and at the same time produce shareholders value. Service innovation can be divided into three categories (Edvardsson et al 2008): (1) type of innovation (service-level innovations), (2) the management of innovation (firm-level innovations) and (3) the innovation context (sector-level innovations). In this paper, we will focus on the second category of managing firm-level service innovations, i.e., creating and managing innovative firm-level services by integrating customers in the innovation process.

By service innovation we here refer to the various phases, from idea generation to market launch with at least some acceptance of the new service in the market. The concept service innovation in this paper includes new services for an organization, further development of existing services as well as services "new to the world". In accordance with the service-centred view, Vargo and Lusch (2004, 2008) argue that value is defined by and co-created with the customers, rather than being embedded in output, in defined products or in service attributes. Grönroos (2008) supports the relevance of the value-in-use notion, but disagree with Vargo and Lusch (2004, 2008) view concerning who creates and co-creates value. Grönroos (2008) argues that value is only created by the customer or the user. Therefore, providers must understand why the customer buys and how to participate in and contribute to the customer's value creation and align to the customer strategies, resources and setting (Strandvik et al 2008). Therefore, service innovations must be customer-based in the sense that value is always realized and assessed by customers on the basis of value in use in the customer's on context.

Vargo and Lusch (2004, 2008) introduced the Service Dominant Logic (SDL) as a new logic for marketing; however Holbrook (2006) contends that his 'concept of customer value' (CCV), which was introduced twenty years before SDL, is also about business as a value-creating endeavour. Who has the real truth regarding creating value, customer value and

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value-in-use? For us the contribution of Vargo and Lusch, Grönroos and Holbrock in various ways to the understanding of customer value is a basis for service innovations. However, they neglect the role of values in creating customer value. Therefore, this paper focuses on the role of values in creating value in use for customers and as a result for other stakeholders.

Edvardsson, Enquist and Hay (2006) argue that *corporate values* also bring value-in-use to customers. Excellent companies are distinguished from average companies by values, and not merely by logical, value-for-money outcomes and cognitive assessments (Johnston and Clark, 2001; Edvardsson and Enquist, 2008). Edvardsson and Enquist (2008) view values as touch-points or triggers that can either contribute to or destroy value, as perceived by customers and other stakeholders. They have introduced *Values-based Service;* where the business model depart from control-based to values-based; where Corporate Social Responsibility (CSR) and Sustainability Developing (SD) can be seen as a driving force of values; and where value creation for customers and other stakeholders go from a goods logic to a service logic. They have also suggested values resonance and values dissonance; to understand how values contribute to value-in-use and customers' assessment of value. Values resonance refers to values that linked to the service and provider that the customer like, support and want to be associated with and support. Values dissonance on the other hand refers to values the customer dislikes and does not want to be associated with and support. We argue in this article that values have been neglected not only in the service research, but also in the innovation literature while at the same time values have become a key strategic issue in most companies, not least in the automotive industry. In this article we therefore will develop a framework for values-based service innovation using the automotive industry and a well-known truck manufacturer as our empirical basis.

This paper is a first attempt to explore the role of values in innovation activities and projects. We use empirical findings from the context of a world leading Truck company and create a conceptualization and understanding of *Values-based Service Innovation*. The field of service innovation and its management is a recent research discipline (van Riel, 2005). "Innovation is the lifeblood of corporate competitiveness, value creation, and sustainable growth" states Jackson (2004). A high innovation rate decreases the negative aspects of trade-offs between social and environmental goals on the one hand, and economic growth on the other. But with a more proactive way of using social and environmental perspectives a more sustainable and more innovative solutions can be reached (Hart, 2007; Edvardsson and Enquist, 2008). This thinking has much in common with the triple bottom line approach (Elkington 1997; Edvardsson and Enquist, 2008) which values-based service is build upon.

The research question for this paper is: How can values create customer value in the knowledge area of service innovations?

The paper should be seen as a start for a more complete article.

Conceptual and theoretical analysis

Value-in-exchange vs value-in-use

The logic of value creation is changing. The traditional view was that value is defined and created in the value chain—that is, upstream suppliers provide input, the focal company adds value, and the product is then passed on downstream (Normann, 2001). According to this view, value is *embedded* in products or service offerings, and is an output of the firm's

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manufacturing or service processes. Companies position themselves in a value chain from a goods logic and the outcome is *value-in-exchange* (Vargo and Lusch, 2004, 2008; Grönroos, 2008). This is the traditional way in B2B marketing including also in the business context of The Truck Company which is the case study in this paper.

To go beyond the value-in-exchange for a B2B-business means that one have to focus more on the value creation processes in the customers sphere as a process of *value-in-use* (Grönroos, 2008, Vargo and Lusch, 2004, 2008; Normann, 2001; Edvardsson and Enquist, 2008). The emerging view differs from the traditional understanding by conceiving value as something that is *co-created with customers*, and then assessed by them on the basis of value in use and consumption experiences. According to this emerging view, the customer defines value and the assessment of value is linked to the customer's needs, wants, values, knowledge, and skills (Edvardsson and Enquist, 2008).

Holbrook (2006) conceptualises value at the individual customer level. His typology is based on three dimensions ('extrinsic/intrinsic'; 'self-oriented/other-oriented'; and 'active/reactive'). These three dimensions result in eight categories of customer value. With regard to the first dimension ('extrinsic/intrinsic') he argues:

> Value is extrinsic when some object or experience serves as the means to an end, performing a function that is instrumental in nature. By contrast, intrinsic value refers to the case in which an experience is prized for its own sake—that is, self-justified as an autotelic end in itself. (Ibid. p. 213)

Strong values drive customer value

There is a link between values and value in Hoolbrok's (ibid.) thinking, but only in the intrinsic dimension. Edvardsson and Enquist (2008) have noticed that Hoolbrok included the notion of 'values' (in the sense of 'ideals') within the intrinsic dimension of customer value (ethics), but he did not pay explicit attention to 'values' in the extrinsic dimension (p. 40). The authors use Corporate Social Responsibility (CSR) in the following way.

> CSR (that is, extrinsic social and environmental responsibility) is inescapably intertwined with the corporate values of the providers of market offerings. At the company level, three categories of such values can be discerned: ethical, social, and environmental. These values guide customers in their assessments of value-in-use, and they also guide companies in formulating their value propositions in the first place (ibid. p. 40).

Strandvik el al (2008) argue that industrial service have conceptually progressed from the output of the provider's production process to the result of a co-creation process in which the customer is actively involved. Although there are attempts to be customer-oriented, especially when the focus is on solutions, an industrial company's offering combining goods and services is inherently seller-oriented. There is a need to develop service innovation conceptualizations and models that are *first*, genuinely customer-based and not provider-driven, *second* based on the service logic (see e.g. Grönroos 2008) and an understanding of drivers of value-in use as a assessed by the customer and third, the role and impact of values resonance and values dissonance.

The insight from Edvardsson and Enquist (2008) show that strong values form the basis for a company's culture. Strong corporate values provide energy and direction to business development in tandem with customers' values and the values of the wider society. In developing a sustainable values-based company, values are pre-eminently important in the company's relationships with its staff, partners, suppliers, shareholders, and the media. A

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company with strong values knows that values are dynamic and they can become stronger in the sense that they become clearer, more relevant, and better integrated in the business model. Values are used by customers and other stakeholders when value is assessed. The values create bonds with customers and thus represent a significant loyalty driver.

Service innovations for creating value

Innovative service businesses are often created by entrepreneurs who are imbued with a clear vision and a strong sense of mission. Such vision and mission are usually based on a firm set of personal values. We can see this in IKEA, H&M, Starbucks and Body Shop (Edvardsson and Enquist, 2008). But strong multinational companies which have been developed during several decades can also be very innovative. Palmisano (2006) label these global actors "The Globally Integrated Enterprises". They use all three spheres (economic, social and environmental) for creating innovative business (Elkington, 1997; Hart, 2007; Edvardsson and Enquist, 2008). CSR helps build a satisfied customer base and that customer satisfaction partially mediates the financial returns to CSR (Xueming & Bhattacharya, 2006). This is most significant for *innovative* firms: "In particular, our finding that the positive financial returns to CSR, are amplified in firms with higher product quality indicates that internal corporate abilities likely generates and sustains financial value for the firm" (ibid. p. 15). CSR is not for charity in order to do good but more of a strategy for innovative service business (Enquist et al, 2007b). Waddock and Bodwell (2007) express this as managing responsibility and introduce Responsibility Management (RM) in analogy with the quality movement. The big challenge in RM is the innovation and improvement processes which have to be more open for and integrate their customers (Edvardsson et al 2008) and other stakeholders in their efforts to further develop value-in-use through service innovations.

Values-based service innovation

What do we mean with values-based service innovations? Values-based premised on a stakeholder perspective of leadership, responsibility, and ethics (Pruzan 1998), incorporating Elkington's (1997) concept of a 'triple bottom line' (economic, social, and environmental) for sustainable development. In a values-based service company, the business model is grounded in service logic, which, in turn, is based on the core company values, the foundation values (social and environmental responsibility), and the customers' values (Edvardsson and Enquist, 2008). The innovation and improvement parts are fundamental for success and the smart solutions will often be related to understand social and environmental issues (Hart, 2007; Edvardsson and Enquist, 2008).

Empirical study

During the spring 2007 Enquist, Roos and Orstadeus designed together with two master students a pre-study of values-based service innovations in the context of a global Truck Company. The students prepared a literature review and a first workshop was held together with Enquist (Researcher), Roos (Researcher and Vice President in the Truck Company), Orstadeus (Director for Product Features and Brand Distinction) and a forth person from the company (Environmental Manager and Feature Specialist). During the first workshop three hypotheses were developed. Approximately after four weeks a second workshop was held. A theoretical driven model, which joins values, value-in-use, and innovations, was developed by the master students in interaction with the researchers and the company managers/specialists.

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One final meeting was then set to test the model against a real life background based on narratives and job experience from the Truck Company. The three core values of the Truck Company are *safety*, *quality* and *environment*. There fore, nine narratives were found based on those values. Narrative seven is used to illustrate what can be learnt from the narratives.

Narrative 1: Blocking drunk driving (*safety*)
Narrative 2: Better breaks for safer trucks (*safety*)
Narrative 3: Keeping all road users safe (*safety*)
Narrative 4: High quality trucks are guaranteed (*quality*)
Narrative 5: Quality is not limited to products (*quality*)
Narrative 6: Lifetime quality in the trucks (*quality*)

Narrative 7: Cleaner trucks for a cleaner environment (*environment*)

> For the Truck Company it is important to reduce the emissions from its vehicles, as 90 percent of the environmental impact is caused during the working life of a diesel truck, and only 10 percent during production and scrapping. For this reason, the Truck Company is constantly working on reducing the fuel consumption, which will directly affect the emission of gases into the environment. In the last ten years the company successfully reduced the emissions by roughly 20 percent, and continues to work with the Euro 4 and Euro 5 standards, while Euro 5 will only be implemented in 2009.

This narrative demonstrates the environmental awareness of customers and other stakeholders which change the value-in-use pattern. The Truck Company knows where the biggest problems of pollution lie down, and aim at reducing them drastically. While doing so, it does not limit itself to expected quota, but has a focus on the requirements of the future, and is staying ahead of problems that may arise. Reducing the fuel consumption of a truck does not only have an impact on the environment, it just as well affects the economy of the trucks owners.

Narrative 8: A cleaner production (*environment*)
Narrative 9: Ecological thinking beyond production and the product (*environment*)

Two written reports (a field report and a master thesis) come out of the whole process (Kroll and Raab, 2007 a, b). The narratives driven by the company core values gave direction for innovation and improvement processes open for the customers and other stakeholders need for value-in-use. The pre study can be seen as a test case of the idea of Values-based Service Innovations to create customer value with the company's core values. It was also the start for writing a more explorative driven article based on an interaction between a conceptual and theoretical analyses of the topic and the empirical findings from the Truck Company.

Discussion and further research

During 2006 – 2008 Edvardsson and Enquist have developed their concept *values-based service* (Edvardsson, Enquist and Hay, 2006; Enquist, Edvardsson and Petros, 2007; Edvardsson and Enquist, 2008). The research based on Edvardsson and Enquists' articles and the book are important contributors to the conceptual and theoretical analysis developed in this paper as well as the findings of value creation from Vargo and Lusch (2004, 2008), Grönroos (2008) and Hoolbrock (2006). This can be seen as the first step for making a full paper. The framework of values-based service in a specific knowledge area *Service Innovation* will be developed further. Based on the conceptual and theoretical analysis which

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has been developed in this paper a deeper explorative study must take place as well as further developed the conceptual and theoretical framework. In dialectic way we can then let the framework meet narratives/ empirical findings from the context of the world leading Truck Company and create a further meaning of the concept of *Values-based Service Innovation*. A more general model will emerge from the deeper study and a deeper contextual learning can done to understand the model.

The paper shows upon the potential original contribution to the study of values based service innovation. It is a long way to go for a B2B-Company to really understand the value-in-use from the customers' point of view and in a proactive way use strong company values and how hose values can affect customer value.

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A combined QFD, AHP and ANP approach for quality improvement and capacity expansion in the Greek Banking sector: Some Preliminary Results

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STRUCTURED ABSTRACT

Purpose

This paper proposes the utilisation of Quality Function Deployment (QFD) in order to detect and translate bank customers' needs into actionable goals for capacity expansion. Specifically, this study aims to identify the selection criteria -"wants" of banks' customers in Greece. Customers "wants" are also related to key market segments to develop the First House of Quality.

Methodology/Approach

A specific questionnaire was designed based on a list of selection criteria that was drawn from previous surveys as well as on the professional experience of the authors. Five hundreds forty nine (549) questionnaires were personally administered to customers of major banks in Thessaloniki, Greece. A total of 1770 customers were approached, yielding a response rate of 31%.

Findings

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Exploratory factor analysis revealed six dimensions regarding bank customers selection criteria. These are: "Simple and effective service", "Innovation Products", "Pricing", "Working Hours", "Network Sufficiency", and "Location". Customers were categorized in six key market segments, based on their most frequently used bank products. These were: a) Housing Loans, b) Consumer Loans, c) Credit Cards, d) Savings Deposits, e) Time Deposits, and f) Funds.

Research limitations

Distributing questionnaires personally did not allow the creation of a completely representative sample of customers of the Greek bank industry.

Practical implications

Measuring customers' perceptions in terms of the six selection criteria dimensions that emerged can support decision making regarding initiatives to be taken. Findings were related to specific bank product categories assisting managers to customize key banking processes to meet customer needs.

Originality/value of paper

The findings of this study provide insights into customers' priorities when selecting a specific banking institution. Furthermore, they relate customer wants to specific market segments based on primary data, forming thus, a robust background for the next steps of the research.

Keywords: QFD, Banks, Customer criteria, Factor Analysis, Greece

Research Paper

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1. Introduction

During the last decade the Greek banking system is characterized by increased level of competition. Competition has become even more intense since Greek Economy joined the Euro currency system. Thus, it becomes increasingly important to investigate methods and techniques that may improve banks' competitive position and as a result, increase their market share and profitability. Retail banking is one of the most important sectors that affect the economic life of any country (Zineldin, 1996). Banks operating in Greece enjoy high profitability levels and there are many opportunities for further development (The Bank of Greece, 2007)

The growing competition of the Greek banking sector as well as the variety of product and services offered by banking organizations have increased the need to identify the selection criteria of financial services' providers.   Thus, a key prerequisite for quality improvement of banks' activities is the accurate determination and understanding of customers' needs and selection criteria (Cohen, 1995). Moreover, the translation of these needs/criteria into specific operational and/or strategic goals and actions are equally important for banking strategies' successful implementation.

Quality Function Deployment (QFD) provides a structured way for service providers to assure quality and customer satisfaction while maintaining a sustainable competitive advantage. QFD focuses on delivering "value" by seeking out both spoken and unspoken customers' needs, translating them into actionable service features and communicating them throughout the organization (Akao, 1990).

The aim of our research is to develop a Quality Function Deployment (QFD) model that supports capacity expansion decisions for banks based on customers' needs and bank selection criteria.

Despite its wide implementation in various service industries, higher education, public sector, hospitality industry, healthcare industry, retail sector etc., accurate determination of customers' wants continues to be an issue in QFD design services. This is mainly a result of the failure in prioritizing customer requirements and determining accurate importance levels of service requirements. In order to avoid these problems, the Analytic Hierarchy Process (AHP) is utilized to determine the intensity of the relationship between row and column variables for each house of quality whereas ANP plays also an important role in determining the intensity of synergistic effects among column variables at each phase.

The model proposes the construction of four houses of quality. The interconnected rows and columns of the four QFD matrices (houses of quality) relate market segments, customers' wants, critical banking processes, critical success factors for banking operations and alternative capacity expansion strategies. More specifically the first house of quality relates key market segments to customer wants. The second house relates customer wants to critical banking processes. The third house relates critical banking services to critical success factors for banking operations and the fourth house relates these factors to alternative capacity expansion strategies. The ultimate goal of these interrelated matrices is to help bank managers in shaping the appropriate, consumer based strategy for improving their capacity and network.

Within the context of this research, this paper presents the results regarding the first house of quality. This house relates key bank market segments to customer wants. For this reason, a field survey was conducted among retail customers of Greek banks in order to identify the key bank selection criteria. These criteria were used as a mean to echo customer needs and wants (voice of customers) from retail banking services. The

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study adds to the very limited knowledge presently available on the bank selection criteria among Greek retail bank customers.

The rest of the paper is organised as follows: The following section reviews previous research efforts to identify bank selection criteria for retail customers. The next section presents the methodology followed for the survey. Section four presents a description of the QFD model and introduces the first house of quality for this model. Then, a thorough description of the results follows which are finally discussed and briefly compared to those of previous surveys.

2. Literature review

The bank selection criteria used by customers have been largely overlooked in the relevant literature. However, a number of studies have attempted to investigate these criteria, mainly through empirical surveys in different countries and market segments. For example, Anderson et al (1976) presented a determinant attribute analysis of bank selection criteria. Specifically, the analysis assessed the principal factors considered in bank selection decisions and their relative importance. These factors were: Recommendation; Reputation; Availability of credit; Friendliness; Service charges on checking accounts; Interest charges on loans; Location; Overdraft privileges on checking accounts; Full service offering; Parking; Hours of operation; Interest payment on savings account; Special services for youths; Special services for women and New accounts premiums or gifts.

Holstius and Kaynak (1995) surveyed 258 bank customers in Finland in order to determine the importance of selected patronage factors used by Finnish customers in choosing their banks. Results indicated that the most important factors were: reception at the bank; fast and efficient services; lower services charges; friendliness of personnel; and perceived confidentiality.

Kennington et al (1996) studied the impact of marketing strategies on the "new" restructured market of the Polish banking system in order to determine customers' key selection criteria for banks. Results showed that the most important variables influencing customer choices are reputation, price, service and convenience.

Zineldin (1996) investigated the role of positioning in guiding the development of marketing strategy for products/services that compete on a number of dimensions, apart from image. The study showed that other important dimensions include substantive attributes that relate to product performance, price, customer relationship, and service availability.

Mylonakis et al (1998) studied 811 bank customers in Athens, Greece, in order to identify the important bank selection criteria of urban customers - holders of saving accounts - in the Hellenic bank market. The results indicated that Greek customers behave in a similar way to those in more advanced bank markets and economies, who are seeking quality service in a safe, fast, and technologically modern environment. The factors with the highest scores were location convenience and quality of services.

Kaynak and Kucukemiroglu (1992) conducted a study in Hong Kong to define the importance of selection criteria used by consumers in selecting domestic and/or foreign banks. The findings were similar to those of previous surveys. More specifically, the most important criteria were found to be: location, availability of parking space, vault location, loans and mortgages.

A relevant study from the customer satisfaction point of view in the Greek Bank sector can be found in Mihelis et al (2001), which indicates that the main customer

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satisfaction criteria from commercial banks consist of: "personnel", "bank products", "image", "service to customers", and "access", while another study related to efficiency measurement – using the SERVQUAL dimensions as perceived measures of quality - was conducted in commercial banks in Cyprus (Soteriou and Zenios, 1999).

Moreover, a number of authors have investigated the effect of specific demographic factors, such as age, on the bank selection criteria. For example, Boyd et al (1994) investigated bank selection criteria in terms of the age of the head of the household. Their findings indicate that for customers aged under 21 years old, reputation plays a significant role in selecting a bank, followed by location, hours of operation, interest rates on savings accounts, and provision of convenient and quick services. Also, Almossawi (2001) studied the bank selection criteria employed by specific customer segments (i.e. college students) of young potential customers (aged 19-24) in Bahrain. Findings revealed that the five most influential factors for bank selection were: convenient ATM locations; availability of ATM in several locations; bank reputation; 24-hours availability of ATM services, and availability of nearby parking space.

Finally, some authors demonstrated the use of the hierarchical approach to analyze consumer preferences for product and service attributes in banks and explored the managerial decision-making implications of the results. For example, Javagli et al (1989) used the Analytic Hierarchy Process (AHP) to assess consumer preferences for bank selection. The results showed that location; reputation; quality; security; and interest on savings (pricing) had the highest rankings. In similar lines, Phuong et al (2000) carried out a survey on bank selection preferences in undergraduates' population. Using AHP, they structured a three level hierarchy decision problem, which showed that undergraduates place high emphasis on the pricing and product dimension of bank services.

In summary, all the above studies designated a number of key bank selection criteria on which banks should focus in order to increase competitiveness and attract a wider consumer base. This list of criteria echoes customers' needs and they should be seriously considered in key bank strategic decisions for those banks that seek to improve quality and customer orientation. Thus, the investigation of these criteria in the Greek context is the starting point of our research.

3. Methodology

For the purpose of our study, in order to investigate the bank selection criteria utilized by Greek customers, a special questionnaire was designed based on a list of selection criteria that was drawn from previous surveys as well as on the professional experience of the authors.

The questionnaire consisted of two sections. The first part elicited demographic information and data regarding the market segment to which customers belonged, which was deemed necessary in order to achieve the objectives of the study. Thus, customers were categorized in six key market segments, based on their most frequently used bank products (this classification is also in accordance with the reports of the Bank of Greece). These were: a) Housing Loans, b) Consumer Loans, c) Credit Cards, d) Savings Deposits, e) Time Deposits, and f) Funds.

In the second part of the questionnaire respondents were asked to rate the relative importance of 43 potential influencing factors regarding their selection decision of

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commercial bank. Responses were measured using a seven point importance scale ranging from "not important at all" to "extremely important".

The questionnaires were interviewer administered. Twenty trained interviewers participated in the research. The population was drawn from customers of major bank institutions in Thessaloniki, approaching every other customer entering a bank institution, for a period of three weeks. Customers from a variety of bank branches were approached, in an effort to form a representative sample, and they were kindly requested to devote some time for the interview. A total of 549 valid questionnaires were collected out of 1770 customers that were approached, yielding a response rate of 31%. While high response rates enable researchers to generalize their findings, response rates of over 20 per cent are considered acceptable (Yu and Cooper, 1983).

The demographics of the participants are presented in Table I. The sample was equally distributed between men and women and among different age groups, thus forming a representative sample of the whole population.

The survey was conducted between November and December 2007 and the data was analyzed with the use of SPSS. Exploratory factor analysis (EFA) revealed the important dimensions of customer "wants" which are then related to key banking processes (First House of Quality).

Finally, in order to reduce the initial number of 43 bank selection criteria and to identify a smaller set of factors to represent the relationships among these parsimoniously (i.e. to explain the observed correlation with fewer factors) exploratory factor analysis was employed (Tabachnick and Fidell, 1996). Principal component analysis with eigenvalues greater than one was used to extract factors, and varimax rotation with Kaiser Normalization was emloyed. Only absolute values over 0.5 were considered. From the original 43 variables which were used in the questionnaires, only 17 were related to each other in order to form dimensions. All variables are valued high from the participants in the research, based on their mean scores. Other parameters regarding reliability were confirmed. Specifically, we confirmed the determinant correlation value. The value of this parameter must be greater than 0.0001 as defined by the literature. In this study the value is 0.006 and is judged as acceptable.

	Frequency	Relative Frequency	Valid Relative Frequency	Cumulative
Men	266	48.5	49.0	49.0
Women	277	50.5	51.0	100.0
Total	543	98.9	100.0	
Missing	6	1.1		
Total	*549*	*100.0*		
Ages 18-25	163	29.7	29.7	29.7
Ages 26-35	135	24.6	24.6	54.4
Ages 36-50	148	27.0	27.0	81.4
Ages 50-Over	102	18.6	18.6	100.00
Total	548	99.8	100	
Missing	1	0.2		
Total	*549*	*100*		

Table I: Sample Demographics

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The Bartlett Test of Sphericity (to test the null hypothesis that the correlation matrix is an identity matrix) and the Kaiser-Meyer-Olkin measure of the sampling adequacy (where a small value of KMO indicates factor analysis is inappropriate) were used to validate the use of factor analysis. The reliability of the extracted factors was assessed using Cronbach alpha coefficient (Cronbach, 1984). The reliability of a measurement instrument determines its ability to yield consistent measurements (Flynn et al, 1994). Reliabily is operetionalized as internal consistency, which is the degree of inter-correlation among the items which comprise a scale (Nunnally, 1978).

The results regarding KMO and Bartlett's test of sphericity are summarized in Table II. Bartlett's test of sphericity was large and the associate significance level was zero. According to Kaiser (1974) values between 0.5 and 0.7 are mediocre, values between 0.7 and 0.8 are good, values between 0.8 and 0.9 are great, and values above 0.9 are superb. The Kaiser-Meyer-Olkin measure for this study was middling (≈ 0.79) suggesting that factor analysis was appropriate for these data sets. Factor loadings were higher than 0.50 indicating their being conceptualized as pertaining to the same construct (Leech *et al.*, 2005). Moreover, the extracted factors had alpha values over 0.78 confirming their high reliability (Nunnally, 1978).

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,787
Bartlett's Test of Sphericity	Approx. Chi-Square	2728,469
	df	136
	Sig.	,000

Table II: KMO and Bartlett's test

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4. Results and Discussion

SPSS lists the eigenvalues associated with each linear component (factor) before extraction, after extraction and after rotation. Before extraction, 17 linear components were identified within the data set. The mean scores and standard deviations for these variables are presented in Table III.

	Mean	Std. Deviation	Analysis N
Working Hours	4.1955	1.46115	532
Branches Number	4.5451	1.44577	532
Hours for customers	3.9492	1.65341	532
Effective Service	5.6128	0.74185	532
Errors	5.4981	0.83361	532
Fast correct errors	5.4906	0.86461	532
Deposit Rate	5.1372	1.27040	532
Loans Rate	4.9041	1.51086	532
ATM Network	5.0977	1.37294	532
Debit Card	4.6598	1.66803	532
Flexible Loans	4.4041	1.61450	532
Low Charges	5.2650	1.18658	532
Benefits Accounts	4.3910	1.50622	532
Products for Youths	3.8985	1.79585	532
Location near Home	3.8083	1.61353	532
Location near work	3.7124	3.20751	532
Service good turn	5.3609	0.83328	532

Table III: Descriptive Statistics for important variables

The eigenvalues associated with each factor represent the variance explained by that particular linear component; for example factor 1 explains 26.88% of total variance (Table IV). The first few factors explain relatively large amounts of variance (especially factor 1) whereas subsequent factors explain relatively smaller amounts of variance. In the final part of the Table IV, the rotation sums of square loadings are presented. Rotation can optimize the factor structure and for these data the cumulative relative importance for the six factors is equal in both solutions (first extraction and rotated). However, the distribution of the relative importance in individual factors has changed (for example, after rotation factor 1 accounts for 15.34% of the variance).

Based on the results of factor analysis, the initial set of 43 bank selection criteria was reduced to six underlying factors. The titles of the factors were given based on the "descriptive approach" reflecting the nature of the items that belong to them (Kim & Mueller, 1978). More specifically, the following six factors were extracted (Table V):

The first factor: "Simple and effective service"
The second: "Innovation Products",
The third factor: "Pricing",
The forth factor: "Working Hours",
The fifth factor: "Network Sufficiency"
The sixth factor: "Location"

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Component	Initial Eigenvalues			Extraction sums of squared loadings			Rotation sums of Squared loadings		
	Total	%of Variance	Cumulative%	Total	%of Variance	Cumulative%	Total	%of Variance	Cumulative%
1	4.570	26.884	26.884	4.570	26.884	26.884	2.608	15.341	15.341
2	1.781	10.474	37.358	1.781	10.474	37.358	2.268	13.339	28.681
3	1.700	9.999	47.357	1.700	9.999	47.357	2.171	12.769	41.450
4	1.287	7.570	54.927	1.287	7.570	54.927	1.594	9.377	50.827
5	1.099	6.465	61.392	1.099	6.465	61.392	1.524	8.964	59.790
6	1.070	6.295	67.686	1.070	6.295	67.686	1.342	7.896	67.686
7	0.773	4.549	72.236						
8	0.681	4.005	76.240						
9	0.656	3.857	80.097						
10	0.563	3.312	83.409						
11	0.547	3.215	86.624						
12	0.497	2.922	89.546						
13	0.441	2.596	92.142						
14	0.429	2.521	94.663						
15	0.380	2.233	96.896						
16	0.278	1.636	98.532						
17	0.250	1.468	100.00						

Table IV: Total Variance Explained

The first factor, "Simple & Effective Service" (mean score 5.49), accounted for 15.34 per cent of the variance in the data. The second factor "Innovation Products" (mean score 4.34) accounted for 13.33 per cent, the third factor "Pricing" (mean score 5.10) accounted for 12.76 per cent, the fourth factor "Working hours" (mean score 4.07) accounted for 9.37 per cent, the fifth factor "Network Sufficiency" (mean score 4.82) accounted for 8.96 per cent, and the sixth factor "Location" (mean score 3.76) accounted for 7.89 percent of the variance. These six factors together accounted for 67.68 per cent of the total variance in the data.

Table V shows the exact criteria that were grouped under each factor. "Simple and effective service" consisted of the variables: errors, rapid error correction, effective service and service good turn. "Innovation Products", consisted of the variables: flexible loans, benefit accounts, debit cards and products for younger persons. "Pricing" consisted of the variables: loan interest, deposit interest and low charges. "Working Hours", consisted of the variables: working hours and hours for customers. "Network Sufficiency" consisted of the variables: branches number and ATM network. "Location" consisted of the variables: work location and home location.

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	Component					
	1	**2**	**3**	**4**	**5**	**6**
Errors	.850					
Rabid error correction	.827					
Effective service	.804					
Service good turn	.599					
Flexible loans		.738				
Benefits accounts		.713				
Debit card		.704				
Products for Youths		.681				
Loans Interest			.852			
Low charges			.739			
Deposit interest			.737			
Working hours				.823		
Hours for customer				.786		
ATM Network					.835	
Branches number					.742	
Work location						.855
Home location						.711

Table V: Rotated Component Matrix

The findings that were derived from the Greek banking sector are consistent to those of previous surveys. Some deviations regarding the specific factor structure are attributed to issues related to the Greek culture and mentality.

In summary, the study confirmed as critical selection criteria for Greek customers: the appropriate pricing, the quality of services, the ability of banks to offer innovative products and services, their operating hours and flexibility, their network and finally their location.

5. Concluding Remarks and Integration of the results into the overall research

The six factors explaining the underlying pattern of the bank selection criteria for Greek customers provide input data for the first house of quality in our proposed QFD model.

This House (Table VI) relates the market segments to the "wants" of the customers. The six factors describing bank selection criteria form the columns of the House and market segments form its rows. Market segments were defined by using the product categorisation of the Bank of Greece, which is an internationally acceptable method.

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	Market Segment	1 %Market Mix	2	3 Simple and effective service	4 Innovation Products	5 Pricing	6 Working Hours	7 Network Syffiency	8 Location	9 Current Situation	10 Competitors	11 Goal	12 Improvement Ratio	13 Weighting Factor	14 Normalized Score %
1	Housing Loans														
2	Consumer Loans														
3	Credit Cards														
4	Savings Deposit														
5	Time Deposit														
6	Funds														
	Importances														

Table VI: The first house of quality (HOQ)

More specifically, the market segments are shown in the first column on the left side and their "wants" (bank selection criteria) are shown in columns 3 through 8. The six columns on the right (columns 9-14) represent the results of competitive analysis. In each row a comparison between the market share for X bank and the market share of the competitors will be made using a 0-100 scale. This percentage corresponds to how well X bank is doing compared to the competitors in that market segment. Furthermore, column 11 (Goal) will indicate where managers of X bank aspire to be in the future with respect to the competition in each customer segment. These percentages will be determined based on the external and the internal analysis for X bank. The last three columns on the right (12-14) represent the outcomes of the related computations. Specifically, the desired "Improvement Ratio" is calculated by dividing the "Goal" by "Current Situation". Column 13 is computed for each market segment by multiplying the "Market mix" by the "Improvement Ratio". This weighted factor indicates the importance of a particular market segment and is then converted into "Normalised Scores" (column 14) that will be used later in the process to calculate the importance of customer wants. The results of this process will be the input for the next house of quality which will relate customer "wants" with critical "banking Processes".

Finally, non-accurate customer needs' identification continues to be an issue in QFD design services. It has been argued that this is mainly a result of the failure in prioritizing customer requirements and determining correct importance levels of

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service requirements. In order to avoid these problems, the Analytic Hierarchy Process (AHP) is utilized to determine the intensity of the relationship between row and column variables in the first house of quality, whereas Analytic Network Process (ANP) plays an important role in determining the intensity of synergistic effects among column variables at each phase (Partovi 2002).
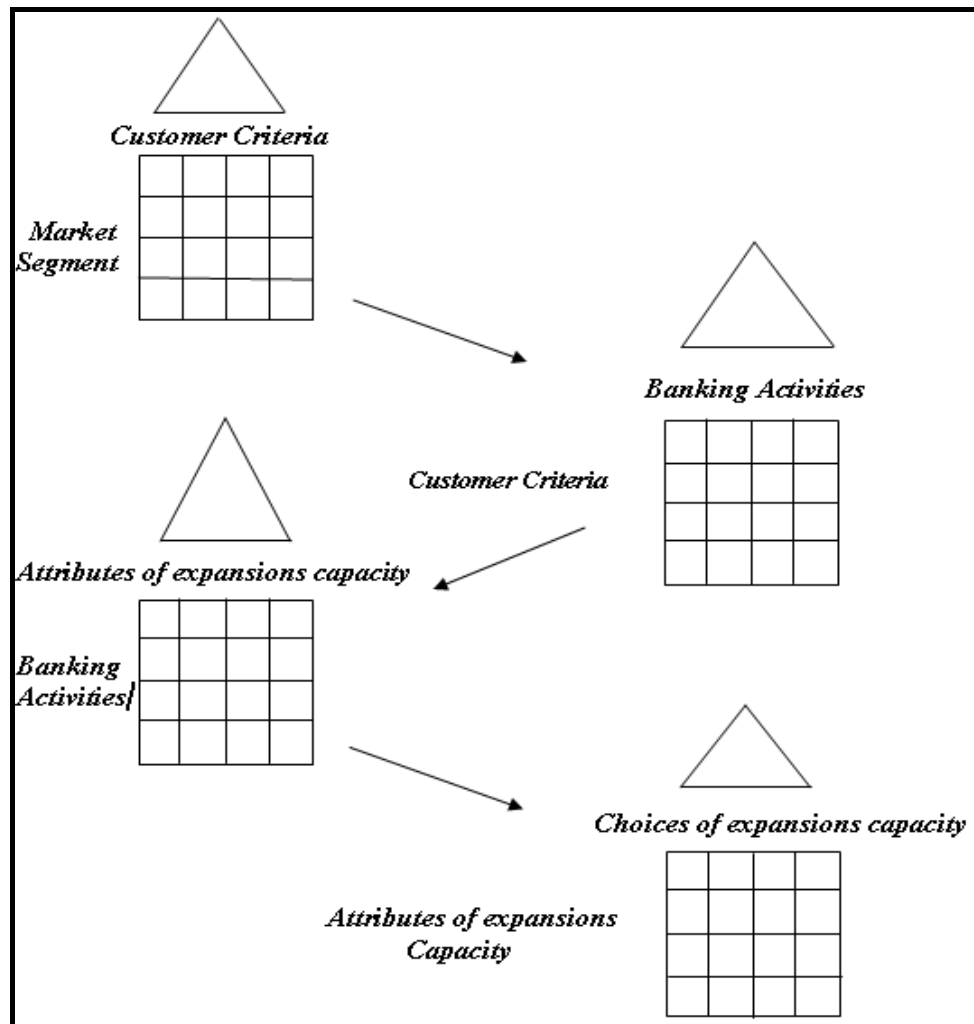
Figure 1: Quality function deployment for capacity expansion in a bank

As a final word, the proposed model, which is based loosely on QFD, (Cohen, 1995; Partovi, 2002, 2006), will ultimately consist of four interrelated matrices (Figure 1): (a) The market segments and selections criteria matrix; (b) The selection criteria and critical banking processes matrix; (c) The critical banking processes and critical success factors for banking operations matrix; and (d) The critical success factors for banking operations and alternative capacity expansion strategies. The choice of specific rows and columns employed in the matrices is determined by external and internal factors applicable to the particular banking organization.

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Rationale for the development of a Swedish local authority-adapted standard supporting sustainability management

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Environmental management Systems, Sustainability Management Systems, standardisation, Local authorities.

General review

Abstract

The trend in society goes from environmental management to sustainability management. A widened systems perspective in many organisations lead to that many realise that it is difficult to view the environmental or the quality or the economic or social issues in isolation and managed by different systems. This trend is valid for both the private and the public sector. This paper focuses the development of sustainability management in Swedish local authorities. It describes the background to sustainability management, the initial phase of the development of a national standard that will support the local authorities' efforts and it discusses potential possibilities and challenges with Sustainability Management Systems (SMSs) and a sustainability management standard. This paper concerns an issue that is rather in its infancy where there is limited practical experiences and where the standard development process just has been initiated. The main reason for writing this paper is to give the reader an initial picture of the development and to open up for a discussion concerning these issues.

Introduction

Using Standardised Environmental Management Systems (EMSs, according to the principles in ISO 14001 and EMAS (Eco-Management and Audit Scheme)) has become a common way to organising and structuring the environmental management efforts within organisations. This approach has been used mainly in industry but also in the public sector. The focus of the systems has, along with the EMS maturity in many organisations, shifted and expanded in its scope, to also embrace the other dimensions of sustainable development: the social and the economic dimensions. To meet and support this development in society, ISO is underway to develop guidance on social responsibility, ISO 26000 (see ISO, 2008). The aim of ISO 26 000 is to support organisations with guidance on social responsibility, its core subjects and how to integrate and implement socially responsible behaviour in already existing organisational systems, strategies and processes. Like the ISO 14000 and 9000 series, ISO 26000 is a voluntary instrument that has the intention to be applicable to all kinds of organisations. Unlike ISO 14001 and ISO 9001, this new standard is not a management system's standard, which means that there is no certification procedures connected to ISO 26000. In a draft version of the standard, important characteristics for social responsibility were defined:

- " Accountability of the organization's impact on society;
- Engagement with stakeholders;

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- Contribution to sustainable development, and
- Integration throughout an organization and its relationships"

(ISO, 2008)

The guidance focuses on seven core subjects. These are:
- Organizational governance
- Human rights
- Labour practices
- The environment
- Fair operating practices
- Consumer issues and
- Social and economic development of the community

These subjects are described and set in relation to social responsibility. Among other things, main principles and considerations as well as benefits from taking social responsibility for these subjects are presented.

In Sweden, many local authorities have long experience from using EMSs. Despite that ISO 14001 intends to be applicable to all kinds of organisations, many local authorities experience that this approach is not totally in concert with the structures and local authorities' way of working (Emilsson and Hjelm, 2005). This has led to that many local authorities have developed their own locally adapted standards that fit their needs and ambitions. However, these locally developed standards build on the main principles in ISO 14001 and EMAS. The same discussion has been held concerning sustainability management and there is a request for a local authority adapted and perhaps more simplified and concrete standard to support their sustainability management. Therefore, a sustainability management standard adapted for Swedish local and regional authorities is under development. This process is in its infancy and the process has recently been initiated. The purpose of this paper is to describe the background to development of sustainability management systems in Swedish local authorities and the very initial phase of the development process of a national guidance standard that will support such development in a Swedish local authority context. This paper is written in a very early phase of the process, just to give a first insight of the current development and ideas concerning sustainability management in Swedish local authorities.

The idea of developing a local authority standard for sustainability management is not new, it was discussed already in the mid-nineties (Levett, 1996). However, such a standard is not yet in use even though the revision of EMAS lead to a somewhat wider scope when it comes to environmental management compared to the old version (compare EC, 1993 and EC, 2001). Furthermore, the concept of sustainability has long been rooted in society, however in the nineties the concept was hijacked by the environmental dimension and when speaking of sustainable development and local Agenda 21, it was mainly environmental issues that were lifted (see Brundin and Eckerberg, 1999). Now it seems like the sustainability concepts used in a more inclusive way in many organisations (and also in the debate in society), which means that all three dimensions (social, economic and ecologic) are taken into consideration when speaking of sustainable development.

Methodological approach

This paper is based on my earlier research on EMSs in Swedish local authorities, in which I have followed several Swedish local authorities' development of their EMS work over a 9

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year period (See eg. Emilsson, 2005, Emilsson and Hjelm, 2002 a and b, 2004, 2005 and 2007). The empirical data is compiled via interviews, postal surveys, focus group interviews and case study methodology. For a more detailed description of the data collection and methodology I refer to the above mentioned research papers. This paper synthesizes the findings from earlier studies to build a general picture of the EMS development in Swedish local authorities in order to explain the development towards sustainability management.

The literature study is supplemented with participative observation in the group that initiated the process of developing a national standard for sustainability management. The group consisted initially of representatives from the Swedish Association for Local Authorities and Regions (SALAR), Swedish Standards Institute (SIS) and the Swedish Environmental Management Council. Once the project was launched observation was carried out in the technical committee for the development of the standard. This group consists of representatives from local authorities, regional and national authorities and consultancy firms. The empirical evidence were compiled and analyzed in order to describe the early stages of the development of the Swedish regional and local authority standard for sustainability management.

Background of the development and use of EMSs in Swedish local authorities

Implementing EMSs in local authorities in Sweden has been an issue since the mid-nineties (Emilsson and Hjelm, 2002a). About half of the local authorities are in the process of implementing and using EMSs (Emilsson and Hjelm, 2002b), however unlike organisations in the private sector, certification is not an obvious aim. Most local authorities use the standards as guidelines or inspiration for designing their own locally adapted EMS standards that are designed from their local conditions and organisational settings. When the EMS concept was new to the organisations it was rather common that the local authorities used ISO 14001 and/or EMAS rather strictly (Emilsson and Hjelm, 2005). After some time, however, many realised that this strict or instrumental approach did not fit with their organisational structures, needs or ambitions. Certification of the EMSs is seldom the aim, much due to that the local authority services are little exposed to competition. After realising that a functional EMS could be put in place without a formal certificate, many local authorities restarted their EMS work and developed locally adapted simplified versions of ISO 14001/EMAS (Emilsson and Hjelm, 2005). However, for the technical departments (that are in charge of heat production and distribution, waste management etc) it is quite common to implement certifiable EMSs. One of the reasons for this is their resemblance to organisations in the private sector and that these kinds of departments sometimes are converted to subsidiary companies (where the local authorities are the owners; Emilsson and Hjelm, 2002b). There are two exceptions from the trend not to certify the EMSs in local authorities. In Uddevalla, the whole local authority organisation is registered according to EMAS (see Uddevalla, 2008) and in Östersund, the whole local authority organisation is ISO 14001 certified (see Östersund, 2008).

When generalising on the earlier studies on EMS implementation and use in local authorities three different phases of EMS maturity can be distinguished: early EMSs, mature EMSs and SMSs (see Table I). This is a rather schematic picture of the development but it has proved to be common among Swedish local authorities. All phases are important for the further development.

Table I. Swedish local authorities' development from Environmental Management Systems (EMSs) to Sustainability Management Systems (SMSs) (from Emilsson and Hjelm, 2008).

	Early EMSs	Mature EMSs	SMSs
Organisational focus	Mainly technical departments Internal	All departments	All departments Society
Scope	Direct environmental impact	Direct and indirect environmental impact	Direct and indirect environmental impact Sustainability
Actors	Mainly the environmental experts in the organization	Central environmental coordinator Most employees External stakeholders	Central environmental/ sustainability coordinator Most employees External stakeholders
Position in organizations	Separate from other activities	Integrated in the overall management system	Integrated in the overall management system

Early EMSs can be understood as EMSs resembling those developed during the 1990: ies. When the EMS tool was/is new to the local authorities it is a rather instrumental tool that gives the organisation support when it comes to structuring their environmental efforts. A new approach implies a period of learning how it functions before it is fully in use and settled within the organisation. It is rather common that when getting used to this new approach it is mainly issues that are rather easy to identify and measure that are included. In this case it is direct environmental impact that is in focus (such as use of resources, transports). In this early phase of the EMS initiation it is common that the EMS mainly is the concern of the environmental specialists in the organisation, even though the management has committed to implement EMS (at least rhetorically). It is also rather common to limit the EMS to one or a few departments where different approaches are piloted before disseminating the EMS to all departments (Emilsson and Hjelm, 2005).

Once the EMS methodology and ideas are settled in the organisation and the EMSs become more settled in the organisations, the EMSs are often expanded from mainly cover the direct environmental impact to also to encompass indirect environmental impact (e.g. environmental impact from education, advice, decisions; Emilsson and Hjelm, 2007a). Furthermore, once the EMS thinking has settled it is common to widen the organisational focus to cover the entire local authority organisation and to have a more integrated approach to the EMS, where it is incorporated into the general management system. Such EMSs can be described as mature. Another sign of the maturity of the EMSs is that, along with the widened systems perspective, employees and also external stakeholders are involved to a higher degree.

The next step in the maturity of the EMSs is an even more extended systems perspective. This is when the organisation has worked with EMS for quite a wile and when the EMS is more or less taken for granted. Then it is common to start reflecting on the difficulty of managing environmental issues in a separate management system and that the overall performance of the organisation would benefit from a more integrated approach where environmental issues are one of several dimensions. Also, and perhaps most importantly the EMS needs to be

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integrated to the overall management system. By expanding the EMS with the social dimension it becomes easier to find improvements and also to motivate departments with less obvious direct environmental impact to actively work with the EMS/SMS. One of the local authorities that have been studied over the years, used to have an EMS that was rather decoupled from the overall management system (Emilsson and Helm 2007b). When the local authority was about to consider ways of reorganisation, it realised that the environmental issues needed to be incorporated to the overall management system in order to gain legitimacy and to be taken seriously. Today, this organisation is underway developing an integrated management system where the budget system, along with environmental management and management of social issues are related and tied together more clearly. By having this approach the local authority believes that its overall organisational performance will improve. Those local authorities where the EMS is integrated or at least clearly connected to the overall management system is connected or integrated, have over the years bee most successful in their EMS implementation. It is rather self evident that the EMS should be connected to the overall management system, but this is, surprisingly enough, not always the case. It has proven difficult to get acceptance for the EMS in those cases where the overall management system and the EMS is not or little connected. One explanation to this is that, in the early phase of EMS implementation, the organisation is so concentrated on formulating their system and the new ways of working that they do not realise the value or need of connecting the two together.

Examples of different approaches to developing EMSs to SMSs

There are many different ways in which local authorities develop their EMSs to SMSs and this chapter describes only a few: the Aalborg commitments, integrated management and Rural Sustainable Livelihood. The main reason for choosing these is that these are rather common approaches among the local authorities in Sweden. In some local authorities they use a combination of different approaches in order to support the development towards SMSs.

Aalborg

The Aalborg charter was stipulated by the participants on a conference in Aalborg in 1994, organised by European Sustainable Cities and Towns campaign. The Aalborg commitments encompass 10 themes under which the local authorities formulate their challenges/commitments (Aalborgplus10, 2008). The themes are:
  1. governance,
  2. local management towards sustainability,
  3. natural common goods,
  4. responsible consumption and lifestyle choices,
  5. planning and design,
  6. better mobility, less traffic,
  7. local action for health,
  8. vibrant and sustainable local economy,
  9. social equity and justice, and
  10. local to global.

The Aalborg process is initiated by ratifying the Aalborg charter and signing its commitments. The organisation commits to perform an integrated Aalborg Commitments baseline review within 12 months from the endorsement. This serves as a point of departure for the target setting and includes a policy context, references to existing political commitments and description of current challenges. The next step is the local participatory target setting process, which is based on the baseline review and other sustainability efforts, such as Local

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Agenda 21. The local targets must be set within 2 years from signing the charter and these must address all ten commitments mentioned above. It is important that the targets are possible to monitor since there is a requirement for regular monitoring review of the progress. This is a rather transparent process and there is a requirement to make the monitoring review available to the citizens.

Today, more than 2500 local authorities in Europe have signed the Aalborg charter (Aalborg plus10, 2008), which means that this approach is fairly wide spread. In Sweden, 23 local authorities and a regional authority has signed up for the Aalborg commitments (as of November, 2007; Aalborg plus10, 2008).

The local authority of Botkyrka is one of the signatories and also one of the first cities in Europe to carry out the Aalborg baseline review and target setting (Botkyrka kommun, 2007). Their vision is to be one of the best local authorities in Sweden to live and work in and where sustainability is a key (Botkyrka kommun, 2005). Botkyrka has used the Aalborg charter as a tool to identify the organisation's strengths and weaknesses when it comes to sustainability management and they have formulated 5 challenges to each of the ten commitments listed above. In order to adapt the Aalborg work to the local work, Botkyrka has identified six main challenges to which the commitments are connected. These are connected to the citizens' work, social safety, education, climate change, public health and democracy. There are two indicators connected to each of the challenges in order to enhance for the following up of their efforts. The challenges are also connected to action plans and to the local sustainability management certification (that will be further discussed below). The progress with the Aalborg commitments in Botkyrka has also been assessed by a peer review team as part of a joint project between Union of the Baltic Cities, SIDA and Coordinamento Agende 21 Locali Italiane (Botkyrka kommun, 2007a).The peer review included a review of the baseline review, the target setting and the published reports. The review resulted in a report where good practice as well as challenges for the future work was presented. This served as an input for the further development towards the local authority's vision: a sustainable Botkyrka.

Integrated management systems

As mentioned earlier in the background chapter, the EMSs in local authorities tend to expand and widen their scope and content. This is, in many cases connected to a more integrated management where all aspects of the organisational performance are taken into consideration. In Botkyrka, the EMS serves as a point of departure and, in combination with their Aalborg commitments and other sustainability efforts, they have expanded their EMS to SMS (see www.botkyrka.se). This standard builds on the six challenges that were presented in the previous chapter, that together aim to make living in the city as pleasant and attractive as possible. All the departments have to design a strategy for how the challenges are to be met. Once the criteria are fulfilled, the departments get a diploma as a proof or appreciation of their efforts. Their work is then followed-up on a yearly basis in order to ensure that they still comply with the local standard.

Another approach to integrated management systems is the EU-project Managing Urban Europe 25 (MUE25) on integrated management towards sustainability. MUE 25 ran between 2005 and 2008, in which 25 European local authorities and regions participated (see MUE25, 2008). This project is a response to the Thematic Strategy on the Urban Environment. The purpose of the project was to create a framework that local authorities and regions could use for developing their already existing environmental management systems and organisational structures of sustainability management. The framework model that the project resulted in

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includes guidance for how to implement an integrated management system for the whole urban area and is thus not limited to the local authority organisation. The idea is that by applying this system, the local authorities are better prepared to improve the implementation of environmental legislation, urban management, municipal compliance with existing legislation and voluntary agreements. There is also support for communication such as environmental assessment and reporting, communication with local stakeholders. The Aalborg commitments are central in this approach to integrated management.

The framework designed within the MUE25 project follows the PDCA-cycle and starts with a baseline review where the local authorities analyses its current sustainability situation (compare with the baseline review made within the Aalborg commitments). Next, the strategic programme and action plan is prepared along with the formulation of a common vision for the future development of the city. Both long-term targets (15-20 years) and a more short term action plan (1-3 years) are crystallised from the vision and the baseline review. Indicators are important components for the following up of the system. The keys to this management approach are participation and co-operation, which also means that stakeholders have an important role for target setting and action planning.
The next important step is political commitment. Without the support and engagement from the political level, it is impossible to succeed with the management system. The politicians or different political key groups should be involved in formulating the strategic programme and action plan. Evaluation and reporting are also key ingredients in the MUE25 framework for integrated management systems. The systems do not have to be perfect from the start, the framework rather suggest to start small and to expand with time (MUE 25, 2008). Three steps of development have been identified:

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1. Territorial expansion: the application of the Integrated management system to the whole urban area with the selection of appropriate indicators and targets
2. Actor expansion: the cooperation with all relevant stakeholders in the city and cooperation with neighbours.
3. Dimension expansion: the integration of all sustainability dimensions into the management system."

(MUE25, 2008)

The framework works as a repeated cycle that is followed up on a regular basis; however a full revision of the system is only needed every 3-5 years.

Rural livelihood

Sustainable Livelihood is one important approach that Uddevalla kommun has focused on in their challenge to develop their environmental management to sustainability management. There are several definitions and ideas concerning this concept (Ashley and Carney, 1999). Scoones (1998) describe some key elements that the concept could encompass:
- Creation of working days
- Poverty reduction
- Well-being and capabilities
- Livelihood adaptation, vulnerability and resilience
- Natural resource base sustainability

In Uddevalla, the focus has so far been on "sustainable citizen dialogue", where broad based participation has been the guiding star (see Uddevalla kommun, 2007). The purpose of this

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pilot project is to find tools to measure the local authority's achievements and customer satisfaction, which in turn is seen as away of complementing the already existing EMS. In the first pilot project they chose one neighbourhood (in a rural area), where the citizens had the opportunities to contribute to environmental and sustainable changes in their close by livelihood. Issues such as local environmental objectives, social measures (youth activities, bus shelters, speed limits through the village and street lighting) were issues that were dealt with.

The development of a standard for sustainability management adapted for regional and local authorities in Sweden

In some way the history repeats itself. In the beginning of the 1990:ies, there was an explosion of a variety of voluntary environmental management approaches in local authorities (and in other organisations of course). In some way, these different efforts were made in parallel to each other without any systematic or co-ordinated attempt. This means that a lot of good and important things were done, but these were not put in the greater context. Then, ISO 14001 was launched and much of the work that the organisations already did, could be structured and linked to a more systematic environmental management by becoming a part of the EMS. Now, we see the same thing happen for the sustainability management. There are many voluntary approaches and efforts made in order to make the organisations more sustainable, of which only a few were mentioned in the previous chapter of this paper. Some of the efforts are made in parallel and with little connection to each other, but with support from a sustainability management standard, these efforts could be placed in the greater context and made more systematically and integrated with the overall management system.

The initiative to develop a sustainability management for Swedish regional and local authorities was made by Swedish Association Local Authorities and Regions (SALAR) together with the Swedish Environmental Management Council. They had identified a need from local and regional authorities for support when it comes to sustainability management. Just to draw a parallel, many local authorities in Sweden experience the environmental management standards as too complicated and that they give little support to this kind of organisations. This initiative was introduced to The Swedish Standards Institute (SIS). SIS was already engaged in the development of the international standard ISO 26000. After some discussions within the ISO 26000 technical committee it was decided that as long as this new standard did not compete with the almost already existing standard, then it was no problem. This argument was met by stressing the uniqueness of the public authority standard and by stressing that the Swedish guidance standard will be a direct application of ISO 26000, however adapted to the organisations of local and regional authorities. By applying those measures and conditions connected to these kinds of organisations the guidance will be more concrete and direct applicable and thereby contribute to a more simplified use. Like ISO 26 000, the regional and local authority standard will become a guidance standard that not is a management system standard for certification.

Once the decision to start the development process was made, a survey was carried out among some local and regional authorities in order to get an idea of what their need is from such a standard. Issues such as purchasing, spatial planning, climate change and education were raised as important issues where support was needed. Many of the local authorities wished for support when it comes to identifying and formulating indicators and following up systems of the issues related to the social dimension of sustainable development. Good practice and exchange of experience are other issues that the local authorities felt as important for the development towards SMSs.

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After scanning the field for the interest of developing a standard for sustainability management ad identifying some important areas of interest, the formal process was initiated by creating a technical committee. The official owner of the process is SIS (the same organisation that is "responsible" for the Swedish participation in other ISO processes). At the first meeting about 30 organisations were represented. These had all signed up to this committee and to the development process of the standard. There are mainly local authority representatives, but also some representatives from national and regional authorities and private consulting firms. The task of the committee is to develop the standard, that will be a guidance standard during the coming two years. The idea is to start to identify a few areas for which guidance could be formulated. Due to the complexity of the concept of sustainable development, it is impossible to try and grasp all issues at once. Therefore, the standard will crystallise, bit by bit by selecting different areas for support development. Areas within which it is probable to start formulating support are purchasing, spatial planning and education. During the standard development process, the members of the technical group will work in smaller working groups with different parts of the standard.

Potential possibilities and hinders connected to a sustainability management standard

As mentioned earlier in the paper, the development of EMSs to SMSs is a new phenomenon and there are few local authorities that have had a functional SMS for such a long time that it is possible to draw any general conclusions. This paper does therefore not come to any conclusions, but rather reflections on possibilities and hinders with SMSs and a sustainability management standard. The most important benefit from having an SMS could be that the organisation obtains a more integrated approach to its management and to its activities, which means that efforts made in different departments or on different levels of the organisation become more co-ordinated once they are identified. This may lead to a more co-ordinated work within the organisation and also to synergy effects. As a result, the overall organisational performance may improve. By widening the management systems, there is also a need for a deeper understanding for all dimensions and all responsibilities and tasks of the organisation and by having this understanding, the prerequisites for further deepening the understanding and learning within the organisation may be enhanced. This integrated approach could also lead to an improved communication and relation with as well internal as external stakeholders.

Using a sustainability management standard could be helpful for those who feel that they need some support or ideas of how to develop their SMSs. Hopefully this standard will be very down to earth and easy to use with practical examples in order to be as helpful as possible. Also, if such a standard is used, there might be a possibility that the local authorities work with similar issues in a similar way and could lead to better comparability between the organisations.

As I see it, the main challenge of SMS and a sustainability management standard is to incorporate the social dimension. Due to the complexity of the social issues (how should the social dimension be defined, what could it include?) there is a risk that these issues are left outside the system. How do you measure improvements on e.g. social security, on preparedness for climate change crisis, democracy issues etc? The effects from managing the social issues are less evident and could be compared to managing indirect environmental impact, which many local authorities excluded from the EMSs in the early phase of the maturity process, due to their complexity. Another important question to ask is whether it is possible to standardise the management of social issues. Another potential challenge when

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developing SMSs in the organisations is to make them as comprehensive as possible and easy to use and understand. There is a risk that the systems become too complex (due to their wide scope and inclusiveness) so that it becomes difficult to actually understand the purpose and to grasp what needs to be managed within the system. Furthermore, the co-ordination of an SMS puts rather big demands on the competency. EMS co-ordinators are often environmental experts or experts on management. However, managing and co-ordinating an SMS requires a broader competency and perhaps it is impossible to find that entire competency in one person and instead there should be a co-ordination group that together holds the entire needed competency.

To conclude, the use of SMSs in Swedish local authorities is not yet fully developed and the standard for supporting their efforts is just in its very initial phase, which means that there still are many issues to be solved and carefully thought about. However, this paper has elucidated some approaches, potential problems and benefits and by continuing the process of identifying potential benefits and obstacles I think that many potential problems could be overcome before they even occur. This paper serves as an introduction to the new sustainability management and hopefully also as a start for further identification of important factors and things to consider, both for the development of the standard and for the local authorities that consider expanding their EMSs to SMSs.

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Virtual Quality Management: 6-Sigma based layout of Quality Orientated Process Models

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1 Introduction

Extensive and efficient quality management throughout all phases of the life cycle of a product is a crucial requirement for a successful business. This is of particular importance for products which are manufactured by innovative processes and for rapid market launches because of the stress of competition.

To manage this challenge, simulation methods are used to optimize the design of processes, process chains and systems with respect to economic efficiency and process-time (Weigert, 2002). In many cases impacting influences and dispersions of machine parameters during the process run are identified and represented inadequately, so reliable predictions about the quality capability of the process cannot be made. The difference between the simulated and the real process is shown in figure 1.
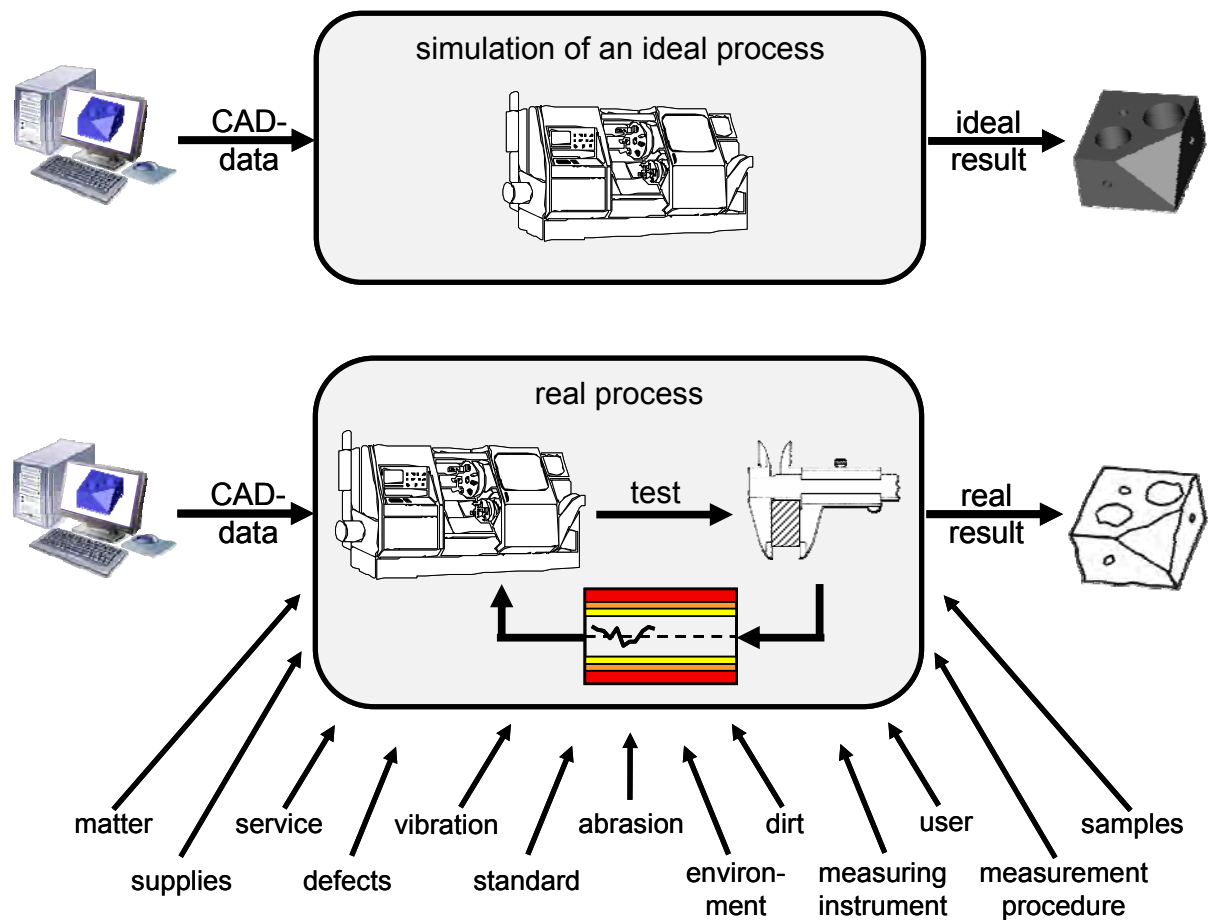
Figure 1: Difference between a simulation model and reality

Dispersions of the real process are typically remedied by the "imposition" of QM-measures after starting the serial production when the real process ramps up. That leads to a significant loss of time and causes a lot of additional effort. To avoid this inefficient practice, simulation models have to be enlarged significantly by enclosing environmental influences and scattering of process parameters. The approach to use the enormous potential of these models and process simulation software to increase the informational value of simulation studies, is called Virtual Quality Management (vQM). By use of vQM, simulation results can be the base for the design of the process with regard to layout, maximal output and robustness and

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moreover for the virtual design and optimization of quality management measures. So it is aspired, that a process with a technically matured QM-tool is available when the series production starts and optimal quality can be achieved "right from the beginning".

This paper contains a general overview of the Virtual Quality Management methodology and a detailed consideration of the guidelines for the efficient proceeding in building up these specific process models.

2   What is Virtual Quality Management?

Virtual Quality Management can be defined as "coordinated approaches to the efficient modeling, adaptation, utilization and analysis of simulation studies for generating resilient knowledge and dimensioning quality techniques for products and processes during the planning stage."

Figure 2 shows the content of this approach and its most important facts. Miscellaneous information about the ideal manufacturing process and the product are used as base for the model-building (process knowledge). This is the same proceeding like working with "ideal"-models. But these Quality Orientated Process Models have to be supplemented with a lot of information about the imperfection of the process and the impact of environmental influences. This has the positive effect that the accuracy of the model increases so much, that in addition to forecasts about the value of ideal process parameters, statements according to quality capability and robustness can be made. But this extra information has to be gained by the increasing complexity of the process model. In order to keep the additional work low, guidelines have been prepared and validated, which help to design such Quality Orientated Process Models efficiently and to handle the complexity.
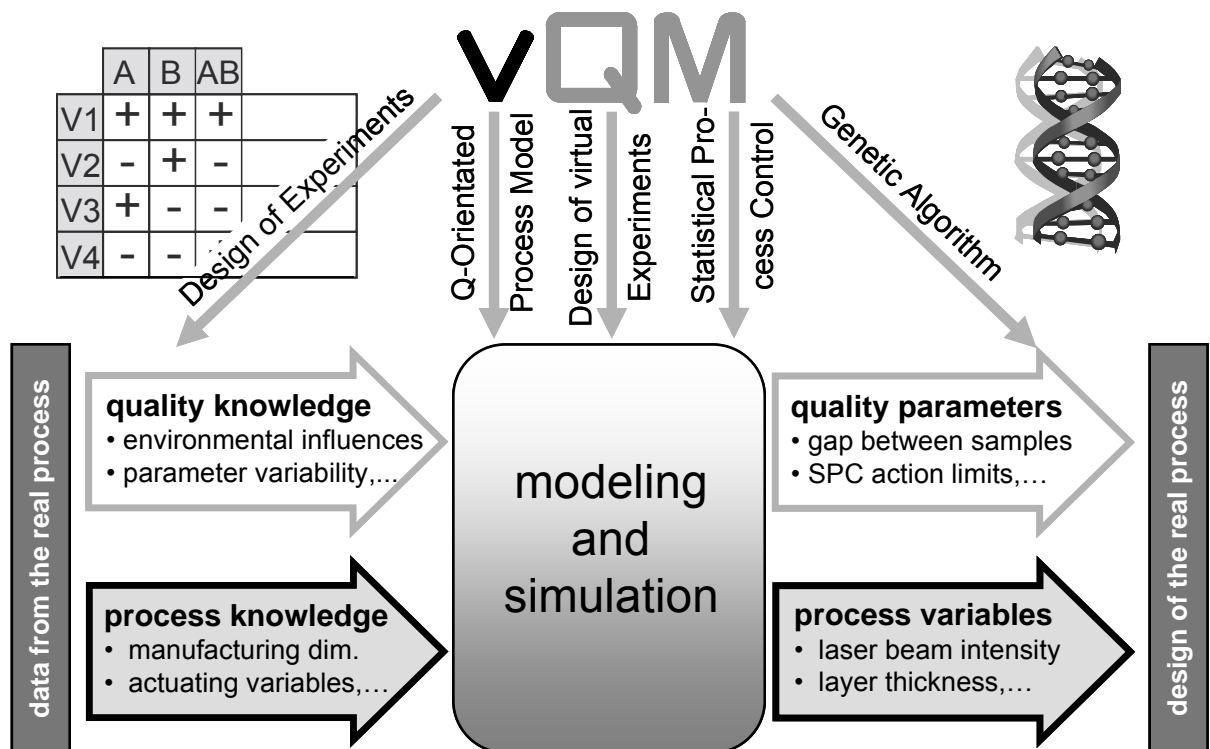
Figure 2: Elements of the Virtual Quality Management

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The designed Quality Orientated Process Models can be used in the process development in two different ways:

On the one hand process chains can be tested and optimized virtually: This means that cost and time intensive test runs can be done by use of the simulation model in a fraction of the time that would be necessary in real tests. Moreover, the manageable sample size in simulation studies can be factor 100+ higher than in the "real world", because it only requires more calculating time and the real production line can produce its parts undisturbed.

On the other hand it is possible to test and optimize quality techniques before the process has been realized. Multiple prognoses about the quality capability of the measurement system, the machine or the process can be performed and the results bear the potential to detect weaknesses in the process chain concept. This information allows initiating necessary changes in a very early stage, when the costs for changes are still relatively low. Furthermore, quality techniques to supervise real processes can be set up, tested and optimized virtually, so that quality control cycles have already proved their liability in a virtual production trial before being integrated in the real process. Hereby an unopposed and undelayed production start-up can be assured and quality techniques like quality control charts - which were reserved for high volume runs up to now - become economically interesting for "middle volume runs".

Process models have been separated in three categories in order to divide the different use cases strictly: Ideal Models, Quality Orientated Process Models and Quality Supervised Process Models. In figure 3 the connections between the diverse process models are described.
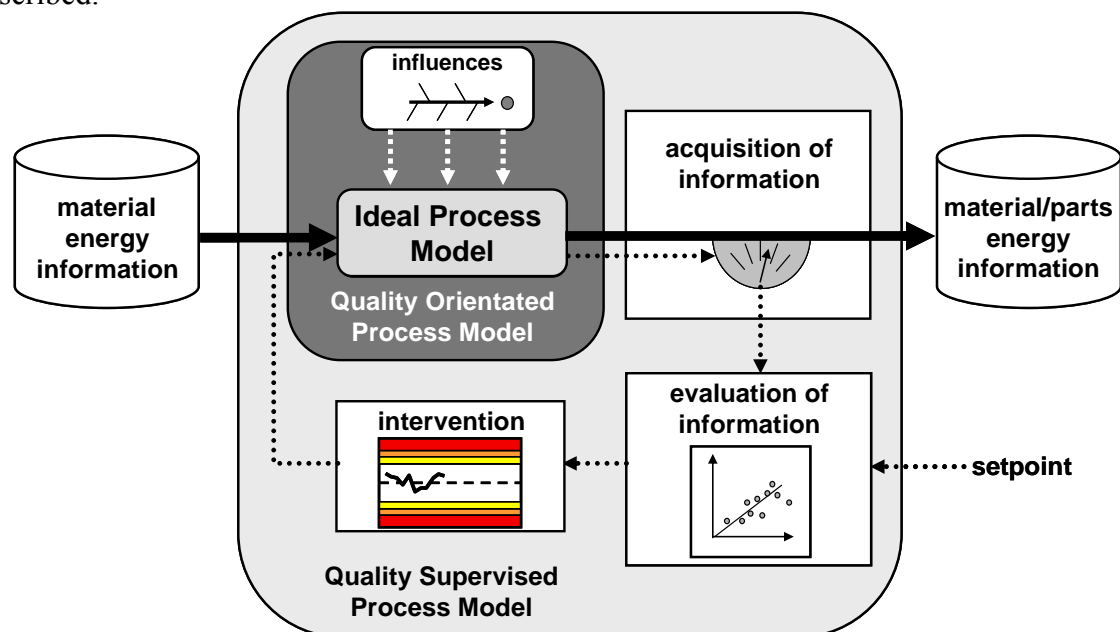
Figure 3: Connection between the diverse process models

By use of Quality Orientated Process Models much more extensive studies can be realized as it was before: The Design of Experiments shall be used for the data collection on the basis of simulation models to ensure a time-efficient progress. Thus some adjustments of this method are necessary, which has to be enlarged and modified to the Design of **virtual** Experiments.

But no statements about the quality capability of the process can be made solely by use of Quality Orientated Process Models. Therefore the process model has to be upgraded to a

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Quality Supervised Process Model. An enclosed control cycle is not necessary for the execution of a machine or a process capability analysis. But if i.e. the parameters of a quality control chart shall be defined and evaluated, extensive modifications are required, which reach from the virtual extraction of samples to the self-acting intervention of the program in the simulated manufacturing process (figure 3). Control cycles can be designed depending on these studies, i.e. by use of the Statistical Process Control (SPC), evaluated and optimized through Genetic Algorithms.

3   Guide to the Assembly of Quality Orientated Process Models

For efficient use of Virtual Quality Management, detailed process models are necessary in a (process) simulation software. But due to the correlation between the accuracy of the process model and its complexity, the user has to be supported, so that he can handle the complexity (Weckenmann, 2008). Thus guidelines were conceived which separate the acquisition of information and the modeling in manageable partial stages and support these stages by fitting quality management techniques:

Based on different approaches for the execution of real projects in the "Design for SixSigma"-methodology (Bergbauer, 2004) a system was sought, which can be assigned for the assembling of Quality Orientated Process Model in simulation software. So the guideline is based on the DMADV-scheme (Define-Measure-Analyze-Design-Verify) (Reissiger, 2007), which is also derived from the well known DMAIC-circle (Define-Measure-Analyze-Improve-Control). As the DMAIC-circle is known as an established tool for optimizing already existing processes, the DMADV-scheme is used considerably earlier in the product-life cycle for the creation of error-free products and processes. Figure 4 shows the connection between DMADV and DMAIC:
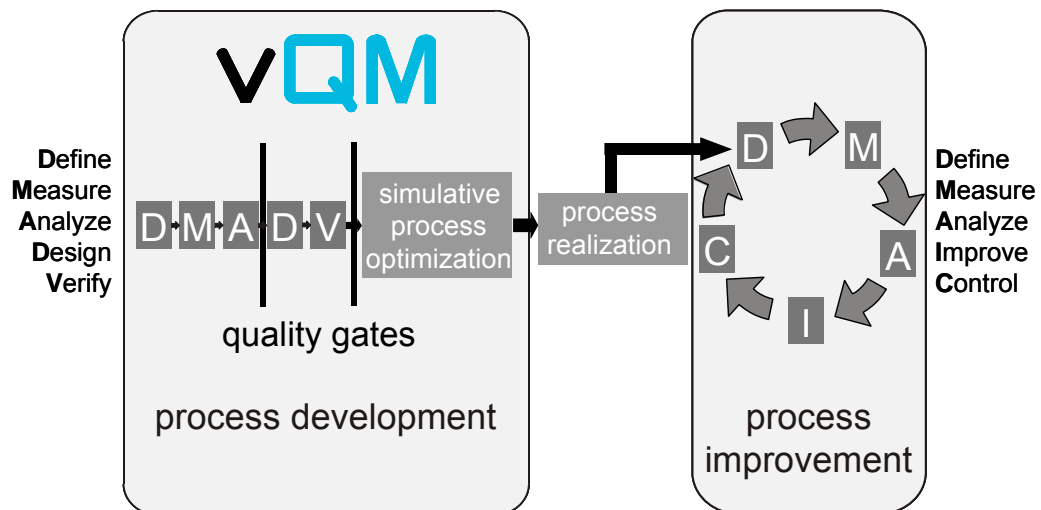
Figure 4: Interrelation between DMADV, DMAIC and vQM

Within the Virtual Quality Management the design of a real process by use of DMADV equals to the mockup of a virtual (simulative) one. A short overview of the single phases with their special specifications for the creation of Quality Orientated Process Models will be given on the following pages. Selected quality techniques for the support of every single stage are recommended within these guidelines. See figure 5 for an overview of the guidelines.

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Define

The relevant general conditions for the creation of the process model are determined in the define-phase. Parts of the framework are the duration and the goals of the project, the resources of available staff, material and finances, as well as the specification of the particular model. These specifications contain especially the definition of the process to be represented, alternatively the process-chain with its particular dependent variables, the process-boarders and the determination of the accuracy of the mockup. In this context it is essential to keep the target-orientation up and to define reasonable bounds. It is very important, especially by illustrating cutting-edge process-models with marginal background knowledge, to engage help of the development department already in this early phase.

To describe a process in vQM SIPOC-Charts (Supplier-Input-Process-Output-Customer) are used, which are closely related to the flow-chart method (Reissiger, 2007). By using such simple process-illustration tools in this very early stage, the results can be carried forward in a structured form to the next phase and the loss of the focus on the process goals can be avoided.

A very important part of the design-phase is the definition of the test-environment:
- parameters and functional connections to be checked,
- range of values to be tested,
- gap between two measuring points,
- general conditions for the whole experimental design,
- etc.

Furthermore, it has to be assured, that necessary data from the real process are - as far as possible - available at the point of testing, to compare real and simulated results. Otherwise precious time will be lost or the accuracy of the simulated model cannot be determined.

All information, which was brought together, has to be recorded in a Project Chart; this document has to be detailed and actualized during the project (Lunau, 2007). It is the central instrument for the project director to manage the task.

Measure

The content of the measure-phase is by far larger than just "measuring": With the general conditions set, all significant pieces of information have to be collected, which are required to create the process model. Three ways of knowledge acquisition have to be considered at that point and should be used in exactly that order: literature research, questioning experts and carrying out real test runs. Literature research in libraries, databases and the internet often gives a general survey of the process which has to be designed as well as the relevant interactions between environmental influences as well as control- and target-variables. This preliminary work is necessary to reduce time-consuming meetings with experts and extensive test runs to a minimum. An Ishikawa-diagram can help to visualize the interactions. If this illustration is filled with the existing pieces of information, it is considered to be a solid base for a brain trust to check the already detected parameters critically and add missing aspects.

As real test runs are very often closely connected with an enormous effort of time and money, they should only be used very rarely as last choice. The tools of statistic test methodology can be quite helpful for the user, which are chosen and used according to the particular precognition.

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Analyze

The acquired data are going to be interpreted in the analyze-phase and proceed into a concept for the model creation. This phase is determining what kind of input parameters, environmental influences and interactions are significant and need to be considered.

In addition to that a raw concept of the simulation model is being acquired: it is of extraordinary importance to divide the process or the process chain into reasonable units as well as to define their functions and interfaces to other sub processes. With this approach, valuable resources can be saved, e.g. the performance of programmers and process engineers. This happens mainly by the minimization of the number of iteration loops, which are normally caused by vague job definitions at the design of the processes.

The concept for every single process unit has to be described in a standardized form, called Modeling Key Document. It contains information about the position in the overall process model, the responsible people in the project, a short textual description, the functional interrelations, which have to be implemented, the interfaces between the modules and the specific testing restrictions for the single module.

In order to move on after this phase, a quality gate must be overcome. When all relevant pieces of information have been collected and have been transferred into a modeling concept, it is reasonable to present these results to a brain trust. If relevant facts are missing or falsely incorporated in the simulation model, changes can be made with a justifiable effort. The extra work to implement modifications at a later point in the modeling process increases strongly in complex simulation models. Here the well known Rule-of-Ten for failure costs can be used as a guideline. It says that costs for correcting errors increase by the factor of 10 per step in the product development process (Linß, 2005).

Design

After a brain trust has approved the model concept, the conversion into a simulation model is the next step. By structuring the process, it is very easy to divide the job up to several people. As the sub units are independent and only connected with other modules by their interfaces defined in the Analyze-phase, they can be built up separately and be composed to a complete Quality Orientated Process Model in the end. By establishing several sub units side by side, the absolute time for the completion is being reduced considerably in the spirit of "Simultaneous Engineering". With a gapless documentation it is possible to ensure that colleagues can understand the work reciprocatively in order to replace each other, if i.e. someone gets sick.

It is important to test the single modules at first separately in a test environment for their operational reliability, before the implementation into the overall model takes place. This procedure reduces the troubleshooting in the overall model to an absolute minimum, which mostly lies in problems with the interfaces between the diverse modules.

Verify

Before the quality oriented process model can be used for information retrieval or for the solution of optimization problems, it has to be validated. Ideally process parameter combinations and ambience parameter combinations are being tested in real test runs and the

same way in simulation models. Once again the tools of the Design of Experiments are being used to reduce the effort in validating.

The comparison of the results from real test runs and simulation studies allows explicit conclusions about the accuracy of the simulation model. Should the accuracy not be reached, which was determined in the define-phase, the process has to be tested again and the model has to be extended by additional parameters and their interactions. Only if the model passes this quality gate, it is recommended to use this model for further simulation studies, on which sometimes "expensive" decisions are made.

Input	project phase	Q-Techniques
project assignment	**DEFINE** definition of the general conditions	Project Chart, VoC, CTQ, SIPOC
process knowledge	**MEASURE** acquisition of information	Ishikawa-Charts, DoE, Flow Charts.
simulation knowledge	**ANALYZE** design of the concept for the simulation model	functional analysis, Black Box-Charts.

Modelling Key Documents

Quality Review to check completeness and correctness
Gate approval through a brain trust

	project phase	
	DESIGN building the simulation model	
data from process and simulation	**VERIFY** validation of the model accuracy	DoE, DovE

Quality Orientated Process Model

Quality second review of the results
Gate approval through a brain trust

Figure 5: Overview of the guidelines

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The guidelines have been tested and optimized intensively by setting up the model of a stereolithography process. Now there is a model available, which forecasts selected process parameters with an accuracy of more than 99 percent according to the variation of environmental influences. This model is the base for other studies and researches in the future.

4 Summary and perspective

The potential of simulation-based information retrieval out of process models is currently not fully tapped by far! The common disregard of environmental influences and imperfectnesses of the process in order to reduce the complexity of the simulation model leads to "Ideal-Models", with which only insufficient conclusions about the quality capability of the process can be drawn. The Virtual Quality Management offers tools from the modeling up to the optimization of quality control cycles, which can and shall be used in the planning stage of a process.

The guidelines for the systematic and efficient set up of Quality Orientated Process Models have been exemplified. First of all the widening of "Ideal-Models" to Quality Orientated and Quality Supervised Process Models has to be mentioned, which leads to a holistic reproduction of the process in simulation models and the increase of the reliability in real processes.

Currently, flexible function-modules for machine and process capability analyses are under construction. Moreover Quality Orientated Process Models will be enlarged by a module, which completes a quality control cycle by the simulation of Shewhart-Quality Control Charts and adequate intervention strategies. It will also soon be possible to optimize the parameters of these control charts by generic algorithms automatically.

The "Design of Experiments"-methodology will be enlarged and adapted for the new application area "simulation". Therefore the specific requirements of simulation programs as well as advantages and disadvantages of simulation studies have to be analyzed, to maximize the benefit and balance the weaknesses. Afterwards the "Design of virtual Experiments"-toolbox has to be set up, to support the user by recommending corresponding quality techniques and by offering specific simulation modules to work off user-defined or automatically-created experimental designs.

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6 Acknowledgment

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Fundamental elements for the successful performance of Six Sigma projects in service industries

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Abstract

Purpose --- Six-sigma has been a powerful and successful tool in manufacturing industries to reduce rate of rejects and to enhance productivity. The service industries are diversified and the features are different from manufacturing industries. Thus, the use of Six Sigma in service industries and its benefits are limited to some specific types of services like health care and banks. This paper focuses on key performance indicators of six-sigma and elements to cover a wider range of services.

Design/methodology/approach --- From the analyses of the service models, service industries structures and also by comparing between the features of service and manufacturing industries, the main challenges in application of Six Sigma in service industries can be identified. Further analyses of these challenges showed that the proper implementation of Six Sigma in service industries requires not only the effective operational strategies, but also customers needs and satisfaction must be considered and designed into the implementation phase.

Findings --- The paper proposed that for the successful implementation of Six Sigma in service industry, instead of just DMAIC, a design phase should be included (DDMAIC). The main meaning of this new phase and its affection will be described.

Research limitations/implications ---

Keywords --- Six Sigma, Service industry, implementation of Six Sigma

Paper type: research paper

Introduction

Quality management has been an important management strategy for achieving competitive advantages and improvements. Traditional quality concepts like Statistical Quality Control[1], Statistical Process Control[2], Zero Defects and Total Quality Management[3], have been key players for many years; While Six Sigma is a more recent initiative quality improvement to gain popularity and acceptance in many industries across the world (Hendry and Nonthaleerak, 2005). The basic elements of Six Sigma like, Statistical Process Control, Failure Mode Effect Analysis[4], Gage Repeatability and Reproducibility and other tools that have been on reduction of

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1 - SQC
2 - SPC
3 - TQM
4 - FMEA

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rejects and enhancing the quality. Six Sigma provides a framework in which all these tools can be performed with management support.

Though Six Sigma was originally developed for manufacturing processes, but today service firms and service functions within almost every sector are using Six Sigma to improve profits and performance. They are deploying Six Sigma in their marketing, finance, information systems, legal, and human resources processes in order to solve the problems. So Six Sigma methodology has a major role to play under these circumstances to pinpoint the major problem areas and devise powerful strategies to tackle such problems which improve the customer experience (Antony, 2004).

Six Sigma methodology

In the midst of 1980s, Motorola (Stamatis, 2004), under the leadership of Robert W. Galvin, was the initial developer of Six Sigma. Six Sigma is a disciplined methodology that uses data and statistical analysis to measure and improve a company's operational performance. It focuses on identifying and eliminating "defects" in processes and has produced hundreds of millions of dollars in new profitability in a wide variety of industries.

A large part of the success of Six Sigma lies in its ability to add a communication layer to industrial processes. Visual information systems populate the working environment with clear signals for parts delivery or tool changeover (Antony, 2004). Briefly, Six Sigma provides a suitable strategy with appropriate indicators toward continuous improvement.

Six Sigma methodology and statistical methods ensure the throughout improvement in quality and reduction in rejects with the definition of targets and visions. Implementation of Six Sigma will be achieved through a series of successful projects. Project can have different sizes and durations. Depending on the scope of the project, they are categorized as: (Haik, 2005)

- Transactional Business Process Project: an improvement of a transactional business process that extends across an organization; such as order processing, inventory control and customer service.
- Traditional Quality Improvement Project: aimed at solving chronic problems crossing multiple functions of an organization.
- Design for Six Sigma Project: a project aimed at incorporating the "voice of the customer" (i.e. customer's needs) and Six Sigma level targets into the design of products, services or processes

Six Sigma improvement model typically has five phases: Define, Measure, Analyze, Improve and Control: (Sleeper, 2006)

Phase 1- Define: In the Define phase, the Black Belt forms the team, including members from different departments affected by the problem. The team clearly specifies the problem and quantifies its financial impact on the company. The team identifies metrics to assess the impact of the problem in the past, and to document improvements as the problem is fixed.

Phase 2- Measure: In the Measure phase, the Black Belt team studies the process and measurements associated with the problem. The team produces process maps and assesses the accuracy and precision of measurement systems. If necessary, the team establishes new metrics. The team identifies potential causes for the problem by applying a variety of tools.

Phase 3- Analyze: In the Analyze phase, the Black Belt team determines what actually causes the problem. To do this, they apply a variety of statistical tools to test

hypotheses and experiment on the process. Once the relationship between the causes and effects is understood, the team can determine how best to improve the process, and how much benefit to expect from the improvement.

Phase 4- Improve: In the Improve phase, the Black Belt team implements changes to improve process performance. Using the metrics already deployed, the team monitors the process to verify the expected improvement.

Phase 5- Control: In the Control phase, the Black Belt team selects and implements methods to control future process variation. These methods could include documented procedures or statistical process control methods. This vital step assures that the same problem will not return in the future. With the process completed, the Black Belt team disbands.
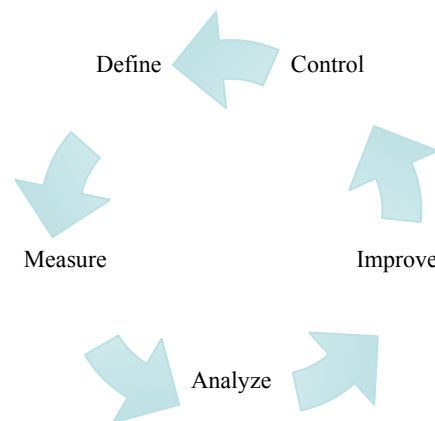
Figure 1- Typical main phases of Six Sigma improvement model

Service industries

Nowadays we witness the increasing role of service industries in the world. So service industries have been more considerable aspects. Even though the concept of service goes back to 1950, but till now there isn't an accepted definition of services. The earliest approach to define service is by Shostack, in which the author feels that services are rendered, it is experienced. Absolutely there are many critical differences between service and product. A service cannot be stored on a shelf, touched, tasted or tried on for a size. Services are generally obtained by engaging an interactive process with the provider (Harvey, 1998). Vargo and Lusch define service as the application of specialized competences (skills and knowledge). Woodall feels that service can or could mean any or all of the following:

- The entire manifestation of a business or not for profit
- Structure perceived to reside within the service sector (e.g. restaurant, insurance company, local council repair depot) – service as an organization.
- The key commercial outputs of a service organization (e.g. bank account, insurance policy, and holiday) – service as core product.
- Any peripheral activity designed to enhance the delivery of a core product (e.g. provision of a courtesy car, complimentary coffee) – service as product augmentation.
- Any product or customer-oriented activity that takes place after the point of delivery (monitoring, repair, up-dating) – service as product support.
- Service as a mode of behavior (helping out, giving advice) – service as an act.

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Service Classification

Classification in manufacturing systems is quite clear, and this is mainly based on their processes. Similar need has been identified for service sector and various researchers have come forward with different ways of classifying services.

The need for classifying arises mainly as

- Lack of exposure to marketing problems and strategies in different industries among managers in the service industries (Lovelock, 1983).
- Working only in one particular type of service industry limits the exposure of managers, which results in lack of ability to identify and learn from the experience of organizations which are facing parallel situations in other service industries (Lovelock, 1983).
- Classifications may lead us to some new ideas and to an understanding of the appropriate management methods and techniques to each service type (Voss, 1992).

So in this paper, we have a brief review of main classifications of services. There is several classification schemes in research articles, selected few are listed below.

Table 1- Summary of selected schemes for the classification of services (Oakland et al [14])

1	Judd	1964	Rented; Owned; Non-goods
2	Shostack	1977	Tangible/intangible service element Domination
3	Sasser	1978	Service/ facilitating goods emphasis
4	Thomas	1978	Equipment/ People-based delivery
5	Chase	1978	High/low customer contact
6	Kotler	1980	People/equipment; customer presence; personal/business; public/private/profit/non-profit
7	Lovelock	1983	Nature of service; relationships; judgment; demand pattern; delivery method
8	Johnston and Morris	1985	Product/process basis
9	Schmenner	1986	Degree of interaction/customization; labour intensity
10	Haywood – Farmer	1988	Labour intensity; contact with customer; customization
11	Johnston	1989	Frequency of transaction
12	Voss	1992	Professional services; service shop; mass services

So in table 1 it is obvious that the attitude to service was changed. As mentioned nowadays services have a wide range of industries and new attitude about service in on the base of professional services; service shop and mass services.

Service industries, new environment for Six Sigma projects

Techniques such as Six Sigma have made lots of noise. After all, a process is a process. If these established, well proven and well documented approaches so can dramatically improve things on the factory floor then they must also be relevant to the white collar factory. But the bases of service businesses are different, because they shift information rather than parts. And the information flows that exist in

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manufacturing organizations simply aren't of the same kinds as the information generated by services.

Service businesses are characterized by unpredictable events that occur in part outside the organization and are largely invisible (Antony , 2004). A service organization may have explicit and defined processes, but any enactment of a process will be highly variable. For example suppose a mortgage application. The product vehicle is, of course, standardized as much as possible. The processes for assessment, approval and enactment are also specified with a high degree of accuracy, but we cannot predict the number of exact journey any single mortgage application will take. The application may need to collect several items of information from parties beyond the organization, such as surveyors and insurers. It may need to be modified in the light of new information, or adjusted to changing customer requirements. Each mortgage application is a unique entity, born of individual customer's need, which evolves as the business attempts to satisfy the goals of all the stakeholders attached to it.

Services, then, are demand-driven (Sehwall, 2003). And 'demand-driven' doesn't just mean that a service experience is triggered by a customer action: demand is a continuous, evolving factor. The processes of a service organization are like a protracted, complex conversation. Our systems help us negotiate between competing aims. This is completely different from the manufacturing areas, where 'demand-driven' is a means of controlling the production tap and where customer choice is reduced to choosing between configurable attributes. In the following table there are fundamental differences between service industries and manufacturing industries.

Table 2- Fundamental differences between service industries and manufacturing industries

Item	Service	Manufacturing
Input	• Information • Tools/Systems • Approach • Inter-personal skills • Work environment	• Material • Machine • Method • Technical skills • Physical environment
Input measure	• Call volume • Call types – eg value versus failure • Customer preference/style • Time measurements • Process performance	• Customer demand • Production schedule • Process performance • Quality measurements
Type of flow	• Information	• Materials
Work flow	• Could follow a number of paths • Open to non-standard response • May have many decision points	• Highly standardized flow • The non-standard is difficult • Very few decision points
Output measure	• Acceptable service • Absolute resolution time • Mean resolution time and variation • Customer satisfaction	• Production volumes • Beat time[5] • Number of defects • Measure quality
Success strategies	• Implement volume • Reduction in variation • Long-term customer relationship • Customer satisfaction	• Implement standard work • Implement problem solving • High quality • High productivity

Challenges in the application of Six Sigma in service industries

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5 - Beat time can be detailed as the maximum time allowed
to produce a product in order to meet demand.

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Six Sigma projects encounter challenges in the case of service industries, because of special features of this sector. On the base of table 2 and some other relevant topics which were mentioned, we can categorize these challenges to eight subjects. Some of these subjects have relevant predecessors or there is interaction between them. Finding solutions regarding to these categorization, will be the next step.

1- High customer satisfaction

Service functions have been an integral part of most corporations. Organizing service functions into a business entity creates a totally different mindset. A service organization acts differently because of a focus on customer requirements and prompt feedback from customers. Service offerings are experienced much faster than products, which sometimes are stocked in a warehouse or a showroom: Once service is delivered, the customer experiences it and expresses satisfaction or dissatisfaction. Because problems must be resolved faster, the challenges in service are different.

2- Various customer's need

Service organizations consist of transaction and interaction components. The transaction component implies more process dependence for outcome of high-volume functions. Such industries include fast food restaurants, direct mail, banking, health care, insurance and ticketing. The interaction component requires more personal care and attention for outcomes of low-volume and high value services. Such industries include sit-in restaurants, specialized health care and personal services. The transaction services are expected to be delivered faster, better and cheaper, while the interaction services are expected to be delivered better, faster and cheaper. In other words, the speed of service is more critical in transaction-based services, whereas quality is paramount in interaction-based services.

3- Relatively unpredictable volumes

Maybe an unpredictable volume in service sectors is one of the most challenges for implementing any quality tools. Because regarding to this challenge, concentration to quality and measuring rejects is so hard. However service companies attempt to predict the distribution of customers, but every prediction will have errors.

4- Nature of task unpredictable

In manufacturing factories each process and operation is fixed and clear, but in service sectors, many tasks must be done which are unpredictable. Because of high customer satisfaction and variant requirements, these companies must do unpredictable ineluctability tasks.

5- Lack of qualified information about quality

In manufacturing industries although materials are handling between different stations, data and information also transfer and analyze. Frequently the range of productions is constant and variety of production is less. So factories collect data from their fixed procedures and then analyze it easily. But service environments have a different kind of information visibility challenge. The problem of weak information and their analyses derives from:

i) Variety of works which are done by service sectors
ii) Variety of customer needs
iii) Less attention to collect and analyze in service sectors

6- Lack of quality indicators and factors

Obviously because of lack of information in service industries in comparison with manufacturing industries, measuring the quality will have so many challenges. The root causes of these problems are:

i) Lack of information
ii) Rapid variant business strategy

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iii)   Difficulty to define quality indicators and factors
iv)   Driven by customer whim
7- Lack of established quality program

Regarding to Deming's cycle, control and getting feed back is one part of any improvement in an organization. So because of lack of quality indicators and factors, establishing a quality program will have so challenges. Consequently lack of established quality program causes poor performance of Six Sigma.

There are so many so many papers which discussed about critical factors for implementation of Six Sigma, But here we attempt to focus on service sectors and categorized the challenges in order to find best solutions. As it shown in figure 2 all of these challenges are driven from two main features of service industries.
-    High customer satisfaction
-    Various customer's need

These features and challenges cause unpredictable volumes, rapid variant business strategy and unpredictable tasks. Because of these many variations, designing and collecting data and information cannot be established in a proper manner. So lack of information is tangible in the most of service organizations. Obviously regarding to these problems, organizations cannot focus on quality which it deserves. So frequently these organizations cannot pursue a proper and comprehensive quality indicators and quality programs. These problems lead the organization to the poor performance of Six Sigma as is shown in figure 2.
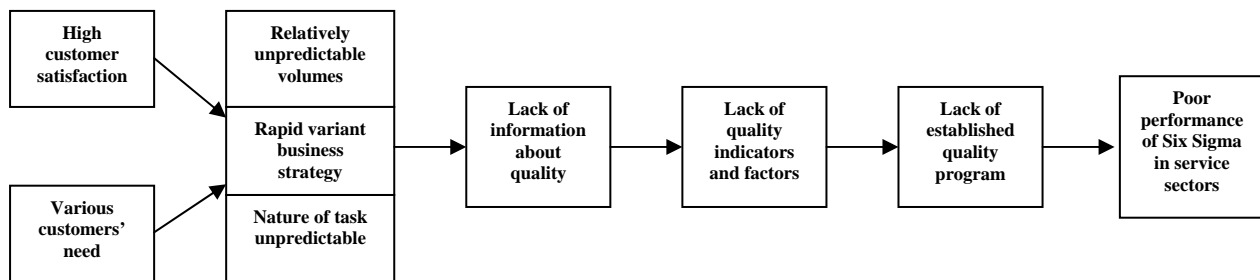
Figure 2- Main causes which leads service sectors to poor performance of Six Sigma

Defining defects in service industries is so important. Because the statistical definition of Six Sigma is 3.4 defects or failures per million opportunities. In service processes, a defect may be defined as anything which does not meet customer's needs or expectations. It would be illogical to assume that all defects are equally same, when we calculate the sigma capability level of a process. So after defining defects they must be ranked. Maybe one defect Spark of so many crucial unsatisfactory and one another defect only cause little cranky responses from customers.

Always in the case of implementation of quality tools, one of main problems is lack of staff knowledge about quality concepts. Even managers sometimes don't have sufficient knowledge about Six Sigma, so they don't acknowledge that. In the other word manager will not support the project strongly. Training is required for all staff members to reduce misbehaviors.

Non-standardization procedures regarding to the processes cause so many problems. So Standardization the performance processes is one of the most important works which must be done initially. After that defining quality factors and indicators must be

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done. Many service industries were confused definition of sufficient factors. These factors can be defined regarding to bellow items :(Y.H. Kwak, Anbari, 2006)

i)   Time (service time[6], waiting time[7], and cycle time[8])
ii)   Cost
iii)   Employee behavior
iv)   Information (accurate and timely information)

So attention to the customer's need and customer satisfaction has a main role in the success of Six Sigma projects. One can identify critical inputs, in-process and service characteristics to monitor customer feedback. This factor is difficult to measure as it varies from service to service. For example, for a call center service, customer satisfaction is measured by the receipt of timely information. For a hospital, the comfort and assurance that patient feels may be is the most important criterion.

There are so many solutions for these problems and challenges which were mentioned. Absolutely for each challenge, special solutions must be taken. Because each challenge has it's special characteristics and features. In order to achieving solutions and key points which can help us for high performance of Six Sigma, key points are categorized in the base of main causes. The results are mentioned in table 3.

Table 3- Fundamental elements for the successful performance of Six Sigma projects in service industries

ID	Challenge	Solutions
1	High customer satisfaction	• Focus on selecting and measuring the correct metrics • Standardize the performance processes
2	Various customer's need	
3	Relatively unpredictable volumes	
4	Nature of task unpredictable	
5	Rapid variant business strategy	• Linking six-sigma to business strategy • Standardize the performance processes
6	Lack of qualified information about quality	• Defining and ranking defects • Focus on selecting and measuring • Focus on selecting and measuring the correct metrics
7	Lack of quality indicators and factors	• Training and education • Strong leadership and Top management commitment • Defining and ranking defects
8	Lack of established quality program	• Training and education • Strong leadership and Top management commitment • Establish quality program strongly • Selection of projects and project management skills; • Aligning Six Sigma projects to corporate business objectives • Attaching the success to financial benefits

Conclusion

In the case of implementing Six Sigma in service environment, it is vital to understand the unique aspects of service processes and identify opportunities for improvement and set up effective measures of performance before launching Six

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6 - the time required to serve a particular customer

7 - The time a customer waits in the system to have the work completed

8 - The total time including service and waiting time

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Sigma projects. Also fundamental elements which were mentioned in table 2 will be proper guide in order to implementation of Six Sigma in service industries. Consequently Six Sigma projects will be successful and brings financial benefits for organizations.

One of the most important limiting factors in this field is the difficulty in quantifying and gathering data from service processes, because most of these organizations don't mention to quality data and quality program. Quality of the service must be defined and measured by defining quality factors. Also quality programs which are focused on opportunities must be established strongly.

Customer has a main roll in service industries. Unconsidered strategy which doesn't include customer's needs and his or her satisfaction as mentioned in figure 3 consequently will cause poor implementation of Six Sigma projects. So for proper implementing of Six Sigma in service industries, the operational strategies and customer (needs and satisfaction) must be considered. This is one of the differences is the application of DMAIC (Define, Measure, Analyze, improve and Control) to a service project. As mentioned most of service industries don't have a proper attitude about customer and related qualified data. So it will be more efficient, if before 'define phase', a phase for considering customer and operational strategies is mentioned. This is a new approach to Six Sigma phases with considering customer and operational strategies in service industries. This application will guide Six Sigma projects linking to customer.
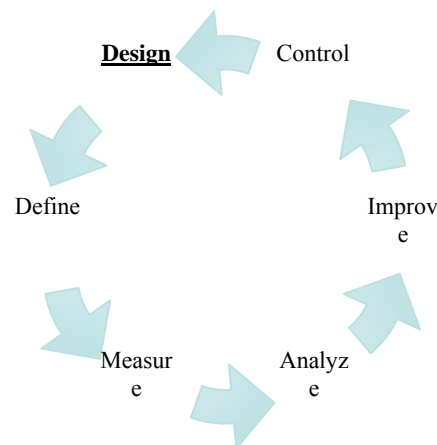
Figure 3- A new approach to the phases of Six Sigma in Service industries(DDMAIC). Design phase means considering the operational strategies, customer and design perspectives in the service environment

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Lean Six Sigma
– a way to make the supply chain resilient and robust

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Abstract

Purpose – This paper discusses how Lean Six Sigma companies can work to create resilience and robustness in the supply chain.

Methodology/approach – A case study in four companies with observations and face-to-face interviews has been conducted.

Findings – Quality tools and methods are very effective to make the supply chain processes robust and less risky. It has been indicated that Lean Six Sigma companies are robust and have some degree of resilience. It is also important to re-invest in activities that make the entire supply chain resilient. The savings generated from the Lean Six Sigma might be re-invested in risk prevention and mitigation solutions as to create redundancies in the supply chain. Sales and operations plans may be more structured and well worked-out in order to be resilient. Different professions and staff from different companies could be represented in the same training *"wave"* which can build bridges between departments, factories and, also, between suppliers and customers. In order to fulfil the highest quality at the lowest total cost, the right quality and resilience must be designed from the beginning. Integrating Lean Six Sigma with suppliers and customers in designing products and processes together in order to strive for resilience will be the next challenge.

Originality/value – This paper provides guidance to organisations regarding the applicability and properties of robustness and resilience in the supply chain. The paper will also serve as a basis for further research in this area, focusing on practical experiences of ways to make the supply chain resilient and robust.
Keywords –Lean, Six Sigma, supply chain management, resilient, robust, demand chain risk.
Paper type – Case study.

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Introduction

Today's business environment is characterised by extremely tight competition between companies, countries and even entire continents. Companies are forced to constantly lean down, reduce costs and outperform. Efficiency and cost-based competition have been highlighted and production is increasingly being transferred to countries with low labour cost. The length and complexity of the supply chain tends to increase, rather than diminish, thereby making the chain riskier and less predictable and hence more vulnerable. At the same time, customers are becoming increasingly demanding. Many company failures can be traced back to an inability to adapt rapidly to changing market expectations (Hoole, 2005; Eriksson, 2003). According to Ericsson (2003) and George et al. (2004) we are living through times of rapid change and the rate of change is increasing. We must recognise change and identify its impact on competitiveness and set out a strategy for mastering it across the supply chain. Consumer products and services now need to take individual life-styles into account – one size no longer fits all. Today supply chain managers are being confronted with a vast array of unconventional risk-related issues, major congestion on roads, in cities and harbours, critical demands forced by a lean supply chain, just-in-time systems, sourcing products halfway around the world, etc. Adding to the complexity of the supply chain management function is a host of uncertainties that have reached levels never imagined before, according to the logistics organisation (the Council of Supply Chain Management Professionals).

How can organisations prepare for crisis situations such as those described above and even gain strength from shock occurrences? They can build resilient supply chains that are capable of withstanding and recovering quickly from unexpected disruptions. Flexibility, redundancy and a risk management culture must be built into the supply chain (Sheffi, 2005). There is however little formal risk management in the supply chain today (Christopher et al. 2003). According to Antonovsky (1987), organisations need to be flexible and resilient because of the supply chain being unpredictable. Similar findings are supported by Christopher and Peck (2004) as they argue: *"In today's uncertain and turbulent markets, supply chain vulnerability has become an issue of significance for many companies. As supply chains become more complex as a result of global sourcing and the continued trend to leaning-down, supply chain risk increases."* The challenge to business today is to create resilient and robust supply chains in order to manage and mitigate the risk and vulnerability, which are caused by longer, leaner and more complex supply chains. Six Sigma is a method to identify customer requirements and fulfil them without unnecessary variation (George et al., 2004). Efficient logistics management requires that unpredictable variations and uncertainties are minimised.

According to Sheffi (2007) and Cranfield School of Management (2003) supply chain resilience is a new and largely unexplored area of management research. Today there are no clear management guidelines, models, or theories for business resilience. Central to the risk debate are the notions of robustness and resilience. Instinctively we would argue that a risk management strategy and a combined Lean Six Sigma management philosophy should aim to create and maintain a supply chain that is both robust and resilient. Recent research has highlighted that the sources of risk in supply chains might be mitigated and managed by a combined quality management philosophy.

It has been indicated in recent articles that the Six Sigma framework focuses on mitigating risks and Lean Six Sigma companies show risk awareness as well as robustness, but today this it is not enough. They must also be resilient. The companies might also use the surplus that Six Sigma projects generate and reinvest this thus making the supply chain and the organisation resilient (Rutherford and Christopher, 2004). The question remains how the

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companies should organise the work at a strategic level in order to be both robust and resilient. This leads to the following research question:

> *What methods are suitable to increase resilience and robustness in the supply chain?*

Resilience versus robustness

The Latin root of the word resilience is *"resilio",* which means to jump backwards. The dinosaurs were very robust but not resilient; in contrast, the rat is resilient. Charles Darwin stated: *"It is not the strongest of the species that survive nor the most intelligent, but the most responsive to change."* In materials science, *resilience* represents *"the ability of material to recover its original shape following a deformation."* For enterprises, it measures their ability and the speed at which they can return to their normal operation level, or move to a new more desirable state after disruptions (Christopher and Peck, 2004). According to Sheffi (2007) resilience measures the ability and speed at which the company can return to normal performance level (production, services, fill rate, etc.) after a disruption.

Based on dictionary definitions, robustness is understood to mean strong, sturdy and constitutionally healthy. Thus a robust process might be expected to produce consistent results with little variation in output. Resilience is the ability of a system to return to its original [or desired] state after being disturbed. In the context of business today a resilient supply chain must also be adaptable, as the desired state may be different from the original. Robust processes may be strong but they are not by definition adaptable (Rutherford and Christopher, 2004).

The quality management way

Variation in any process is an issue. If everything were constant and predictable, there would be few problems in business. The challenges arise because of variations. Hence, if variation can be reduced and monitored, the consistency of the output could probably be guaranteed and reliable. The quality management tools and methods as process control and design of experiments become the means by which variation in output is reduced and afterwards monitored.

The Six Sigma management philosophy searched for a robust quantitative method that would drive variation out of processes and thus guarantee the reliability of their products (Eckes, 2001). The company Ericsson AB defines Six Sigma as *"A strategic initiative to reduce costs of poor quality and customer dissatisfaction using a systematic problem solving methodology emphasising variation reduction".* Six Sigma can be seen as a management philosophy, which consist of a framework (Magnusson et al., 2003), see figure 1.

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The Six Sigma Framework
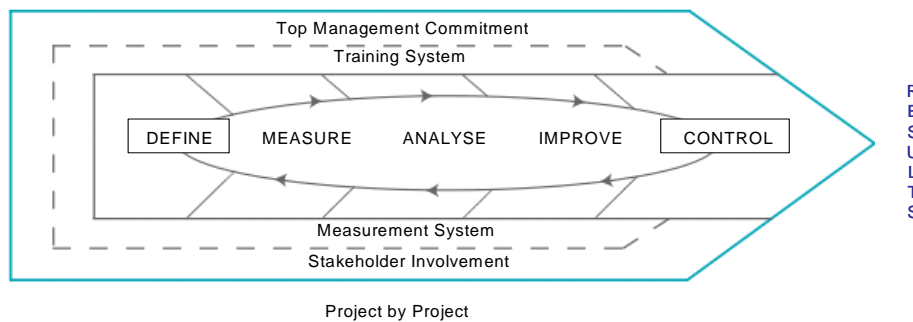
Figure 1   *The Framework of Six Sigma (Magnusson et al., 2003).*

Important features and framework of Six Sigma at Ericsson AB are the focus on cost reduction, variation reduction, customer satisfaction, systematic training in problem solving, common problem solving language, improvement agents, (Black Belts, Green Belts, etc), strategic edge/top management involvement, as well as a measurement system for identifying new improvement projects and for having an overall view on the organisation, over time. Six Sigma could also be described as a data driven improvement programme for reducing variation, which focuses on continuous and breakthrough improvements (Magnusson et al., 2003). Improvement projects are driven in a wide range of areas and at different levels of complexity, in order to bring processes under control and to improve process capability by reducing variability. According to Ericsson AB the objectives of Six Sigma is to reduce unwanted variability that results in cost reductions and increased customer satisfaction. The reduced variability may also lead to improved delivery precisions and yield, which also lead to decreased risks and improved robustness.

Six Sigma tools and techniques enable the proper execution of the DMAIC cycle and ensure that decisions are based on qualitative and hard quantitative evidence.

Lean and Six Sigma are two of the most popular management philosophies, but why not take the best of both worlds? Some companies have merged Six Sigma and Lean practices (Magnusson et al., 2003). Recently, the term Lean Six Sigma has been put forward by George et al. (2004). They specifically claim: "*Lean Six Sigma helps companies flourish in a new world, where customers expect no defects and fast delivery at the minimal cost.*" Furthermore Lean needs Six Sigma and Six Sigma need Lean (Sörqvist and Höglund, 2007), but the power of integrating Lean and Six Sigma principles is quite dramatic. Lean philosophy takes care of waste across all processes and focuses on speed, whereas Six Sigma focuses on design, eliminating defects and driving out process variation (Gerge, 2002; Andersson et al., 2006). By applying these philosophies simultaneously, organisations can improve customer satisfaction, increase process speed and quality of product and service, whilst reducing cost and invested capital in ways that make the supply chain even more robust and resilient.

Lean Six Sigma in the supply chain

The last year some companies have extended Lean and Six Sigma in the supply chain. Experience from Lean Six Sigma companies today indicates that after a few years the companies have improved considerably within the focal organisation and have started to realise that it is their suppliers who create problems for the company. In approximately one third of the Six Sigma projects the main root cause of the problems will be found outside the focal company and if the projects expanded outside a department or better still, outside

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the company, the logistics objectives, risk mitigation and the savings were additionally improved. The next step will be to expand the Lean Six Sigma outside the company (Andersson and Torstensson, 2006).

Goldsby and Martichenko (2005) define Lean Six Sigma in the supply chain as: *"The elimination of waste though disciplined effort to understand and reduce variation, while increasing speed and flow in the supply chain"*. It is about looking closer at the seven logistics wastes, inventory, transportation, space and facilities, time, packaging, administration and knowledge. If Six Sigma tools and methods are applied to squeeze out variation in time, lead-times might become more reliable and safety stock levels can be reduced. It would appear that Six Sigma offers a route to creating more robust supply chain processes that reduce the risk of non-conformance and hence produce a more reliable output. In a steady world this might be enough, but today faced with unpredictable events our supply chain processes also need to be agile and responsive. On the other hand if enterprises have control over their supply chain processes they are in a good position to control and monitor a shift in output. The key lies with Lean Six Sigma process control and monitoring. But to achieve and sustain the shift we might need some spare capacity (Christopher and Rutherford, 2004).

Method

A case study in four companies has been performed, with observations and face-to-face interviews. The findings are supported empirically by on-site interviews and by observations in three of the companies. The selection of companies was made with the following criteria: the companies must have used Six Sigma for at least two years, have run more than ten Six Sigma projects, and have applied Lean and TQM philosophies. All the companies were selected from a Six Sigma association. The selected companies were: Volvo (two people), SKF (five people), Ericsson (five people) and AlfaLaval (one person). All companies were using a typical Six Sigma philosophy and two of them had previously a typical Lean philosophy. Today all of the companies combine Lean and Six Sigma. All the companies accepted to participate in the study and the interview response rate was 100 %. Interviews were performed with Six Sigma Champions in three companies, Black-Belts in four companies, Lean coordinators in one company, Quality managers in two companies and division managers in one company. Different respondents have been asked the same questions, notes were written down and the interviews were tape-recorded. In Ericsson and SKF more time has been spent with observations and interviews. The material has been analysed through theories, methodologies and tools from the disciplines of TQM, Lean, Agility, Six Sigma, supply chain management and risk management. The used definitions of Lean and Six Sigma are from Andersson et al. (2006).

Case study

Ericsson has been exposed to a number of risks and incidents since 1990 as a result of outsourcing and leaning down, as well as having longer and more complex supply chains. A catalyser experience, an accident at a supplier's, resulted in a shift in perception regarding risk management. This accident has been widely reported (Norrman and Jansson 2004, ;Wall Street Journal, 2001). A stroke of lightning caused a small fire at one of Ericsson's smaller subcontractors, who also supplied their competitor, Nokia. From a plant perspective the fire was negligible, but the thunderstorm also caused some power fluctuation and there was no spare diesel motor to power the fan to meet Clean Rooms requirements. The consequence of the fan stopping was that the plant produced

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contaminated chips, and Ericsson had no other supplier of that special chip. The real impact was unsatisfactory quality for six months, costing the company 400 billion dollars. The company lost many months of production as a result of not taking swift and decisive action. In contrast, Nokia had more than one supplier and acted much more quickly and firmly – for them the accident was negligible. The price of not being resilient in this situation was for Ericsson a production loss of mobile phones, which lasted many months, and the accident may have triggered a withdrawal from the mobile phone terminal business (Norrman and Jansson, 2004).

Today Ericsson knows that the leaner, more integrated and longer a supply chain is, the more uncertain, and sensitive to accidents it is. Modern supply chains are more vulnerable due to factors such as outsourcing, fewer suppliers, reduced buffers and increased demand (Svensson, 2000). The above-mentioned accident triggered off changes at Ericsson, to improve analyses, to assess and manage risk, and to act more swiftly.

The Ericsson facility in Borås, Sweden, is the world's leading manufacturer of microwave radio systems, and holds over 40 % of the short haul market, far more than any competitor. The factory is one of the best in the Ericsson Group. An international survey, Probe, rated the Ericsson plant in Borås as World Class in the survey's top category. Ericsson's Six Sigma Centre with training responsibility for the entire Ericsson Group is located in Borås. The factory has carried out many Six Sigma projects and has been applying the Lean Philosophy in order to make the company's processes robust (Andersson et al., 2006; Andersson and Torstensson, 2006). Today the Black-Belts are even trying to include robustness and resilience when working on Six Sigma or design for Six Sigma projects. For example, a Six Sigma project was initiated due to the need of improved delivery precision and flexibility. The situation was that the Supply Unit wanted to store a minimum of products, whereas the Market Unit preferred to offer prompt delivery, see figure 2.

The de-coupling point
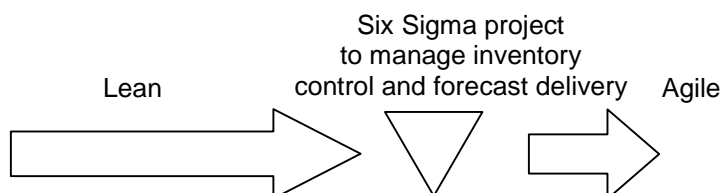
Figure 2   *The Supply Unit does not want to have Products in Stock, whereas The Market Unit Wants to Have a Large Stock.*

In order to find the root causes of the problem, in-depth interviews were conducted both internally and externally. More than half of the problems were found to be the result of incorrect forecasting. The suppliers complained of regularly changed order quantities. The main preventative solution to these problems was to construct an SPC (Statistic Process Control) Chart, and an EWMA (Exponential Weighted Moving Average) Chart.

If, for example, the EWMA chart had been used in 2001 when customer demand declined, Ericsson in Borås would have been able to react up to six months earlier. The chart can be used to monitor risk, e.g. new customers entering the market, customers changing their purchase behaviour, a decline in demand and incidents involving local environmental risk in a region. In 2006 Ericsson saw that the chart did not follow standard patterns: it issued a warning week 46. Now this can be linked to a decline in the Indian and Malaysian markets. Ericsson could react much faster thanks to the chart. Supply risks have also been avoided thanks to the chart and related procedures. Today the chart is used for making decisions

using facts to forecast the capacity of activities, from a day-to-day basis to a monthly basis, e.g. staff training, machines loads and storage space. Earlier, supply managers and departmental managers made regular corrections and modifications to the work plan. The earlier forecast error figure was 20 % and variations in order plans were over 20 % (between actual demand and delivered product). Today, inaccurate delivery precision is only a few percent and variation is less than five percent. The order plans have become much more robust. For example, in 2005 Ericsson changed their forecasts two times per supplier per year; earlier there were twelve changes or more. The price to be paid for robustness and resilience in dealing with changing customer behaviour was the investment in the Six Sigma project, the construction of the Chart and related routines. Ericsson re-invested in activities that made the supply chain even more resilient in order to reduce supply chain risks and to become more agile. In order to let the Chart do the job, a changed behaviour was needed, i.e. staff needed training.

Another way of achieving robustness is to store a standard product, gaining buffer time in which to deal with changed customer demand and to handle less frequently ordered items. The company has re-invested in additional risk mitigation procedures and ways of monitoring solutions, as well as in collaboration activities to improve resilience in the supply chain. Today the policy is that everyone must be a risk manager.

After the fire, Ericsson reorganised and introduced new tools. The new approach includes analysing, assessing and managing risks along the supply chain, and means working closer with suppliers in order to minimise risk and to find efficient levels of risk and prevention solutions. Discussions with suppliers are initiated and analyses made of their agile performance, i.e. the suppliers' ability to react to changing/changed conditions, particularly reaction time, swiftness of response and ability to handle large order quantities. All suppliers must declare how much and how fast they can supply on a weekly basis in MRP (Medium Range Plan) and SDC (Secured Delivery Capability), see figure 3. Discussions are continuously held with suppliers about future risks, supply, demand and environmental risks in particular. Based on that, a pre-S&OP (Sales and Operation Plan) is conducted. The next step is to perform a Sales and Operation Plan by checking the EWMA Chart and collecting information from the Supply and Market units. Then a Pre-TDM (Tactical Dimension Meeting) is held. Simulation and scenario events are used to map the flow between Ericsson and their suppliers in order to understand risk sources and critical paths and to try to understand the impact of any accident. Finally an MRP and SDC are sent to the suppliers, outlining how much has to be supplied each week as well as how much can be changed from the target supply. An annual forecast plan for each month is also provided. This procedure is repeated every month.

The outcome of the procedure has so far resulted in Ericsson in Borås having made joint re-investments in machinery with some suppliers in strategically important areas. Additional suppliers have also been contracted to make up for redundancies in some regions. A future effective solution is to use an S&OP team to create suitable Six Sigma projects in the supply chain. This team usually has the best overviews of lead times, demand variations and other related risks in the supply chain. Today the EWMA Chart, MRP and SDC are employed for making decisions, using facts to forecast the capacity of almost all activities, from a day-to-day basis to a year-to-year basis, e.g. investment, staff training, machines loads and storage space. Earlier, load and forecasting plans were based on decisions by departmental managers, supply and logistics managers, the managing director and market companies. It was management by correction, and the more corrections, the less precision. Ericsson in Borås found that it was better to steer the car using the rear view mirror.
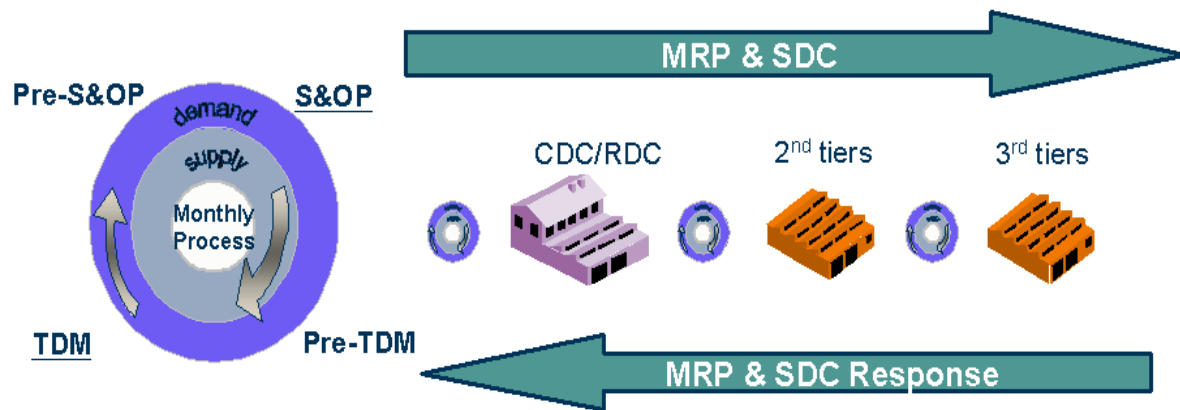
Figure 3 *The Figure Describes the Procedure Analysing, Assessing and Managing Risks along the Supply Chain. MRP (Medium Range Plan), MRF (Medium Range Forecast), TDM (Tactical Dimension Meeting), S&OP (Sales and Operation Plan), CDC (Customer Distribution Centre), RDC (Regional Distribution Centre), SDC (Secured Delivery Capability).*

Lead-time and delivery precision are vital to meeting customer demands. The postponement strategy and customisation of the product is carried out just before delivery. Another strategy is to give the finishing touch to the product just before delivery to the customers as well as to have suppliers of late refine parts in a near region. To sum up, the stored products in the de-coupling point can sustain common as well as special causes of variation or risks up to a few weeks. The SPC chart and the procedure above (MRP and SDC) can detect special causes of risk in a month, thus making Ericsson factory in Borås robust and more resilient than before.

Today, the demand for resilience may be even more pronounced. The entire Ericsson division may follow the good examples with Lean Six Sigma philosophy at the factory in Borås. On the 16th of October 2007, - Carl-Henric Svanberg (CEO) declared that the operating income and cash flow would be lower than expected. The sales decline resulted in an unfavourable business mix and damaged the company's margins (www.CNNMoney.com, 2007). The shareholder value fell by over 20 percent in a day and by over 50 percent in four months. Ericsson's facility in Borås could see this sales decline first in Ericsson division, thanks to the EWMA chart. If Ericsson had been connected to the Six Sigma framework and projects with the company's strategy and S&OP caps as well as training more Black-Belts in the entire Ericsson division as SKF has done, there might not have been such a dramatic decreased shareholder value and the recovery might have been effectuated more rapidly. This standpoint is also supported by Peter Häyhänen, Champion Black-Belt, responsible for Ericsson's Six Sigma reproducing in division.

Today SKF has integrated Lean, TQM and Six Sigma. According to Tom Johnstone (CEO), Six Sigma is the best philosophy as it contains the process, the tools and the way of working that helps SKF set a new standard in the market place, but there is a need for a change of culture. One of the objectives is to spread it as an evolution by showing great project savings and improved strategy objectives. In three years the hard savings have been over 60 million Euros. Over 250 Black-Belts and almost 1 500 Green-Belts have been trained. The Black-Belts' goals are to accomplish two fulltime improvement projects in a year, in order to improve SKF's strategy objectives. After two years' fulltime improvement, the leader will often be a future leader in some part of SKF, thus spreading the culture and language. According to the division Quality Manager Claes Rhenberg, the atmosphere has been improved thanks to the fact that decisions based on facts do not appear as emotionally charged to the staff. Furthermore Six Sigma has given SKF a common language which has built bridges between departments, factories and, also,

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between suppliers and customers. For instance, SKF has developed application solutions together with Caterpillar, which also uses Six Sigma. SKF has also carried out Six Sigma projects together with suppliers in their factory. Today the companies Caterpillar, General-Electric and Honeywell have even made it a requirement to work with Six Sigma.

SKF Green-Belt training differs from other organisations' (Sörqvist and Höglund, 2007). First, it has a duration of ten days; other companies often use four to eight days. Second, a comprehensive project with a certain amount of saving is required, which is not common in the Green-Belt training. Many Six Sigma companies have no Green-Belt training or for managers only. Third, different professions are represented in the same training *"wave"*, which creates networks based on personal relationships, e.g. managers, supply chain staff, engineers, supervisors, operators, as well as front line staff sharing knowledge. According to Michael Jacobson, Master Black-Belt, the visibility and the overall picture of the company's processes have been improved, thanks to the cross-function staff participation. SKF has invested much in training front-line staff and operators in risk management and improvement strategies and tools. Due to the importance of spotting the risks in the beginning, about 20 percent of the participators in the Green-Belt training are front-line staff. SKF tries to evolve a risk management culture by creating common values, culture and rules, especially a culture that supports resilience, e.g. when formal policies and routines do not cover up, all staff members are expected to be innovative and enterprising in solving problems.

In the future, the processes must acquire additional improvements. Tom Johnstone has stressed the importance of design for Six Sigma, *"it is not easy to fulfil the highest quality at the lowest cost, if the right quality has not been designed from beginning"*. Integrating Six Sigma with suppliers and customers into designing products and processes together will be the next challenge. This view is shared by Niklas Lövmark, Master Black-Belt at Alfa Laval.

There is an insurance department at SKF, which has a risk survey view of the whole SKF; today being a quality manager means trying to prevent risks. Cleas Rhenberg has regular meetings with the insurance department and quality managers at all units about future risks. If something has occurred or could, Black-Belts will be set in to solve it. Usually, the solution and prevention of the problems or risks can be divided into three areas: quantitative, qualitative and innovation problem solution. For quantitative problems -Six Sigma philosophy is often most suitable. Lean philosophy is to be recommended when the solution is of a qualitative nature (but they have integrated some tools and methods from both philosophies), and for innovation, Design for Six Sigma - (Sörqvist and Höglund, 2007). Both Ericsson and SKF have this approach.

At SKF both strategic and tactical Six Sigma projects are performed. First of all the projects are passed through a filter, which visualises the most suitable project model and project. There are four different project approaches; *"Just do it-"*, a design for Six Sigma-, a Lean- or a Six Sigma project. One drawback of the Six Sigma project is that it often takes 3-9 months to finish. In general, the identification of suitable Six Sigma projects is visualised by breaking down a SKF vision to division strategy objectives and, finally, to business unit strategy objectives. The projects are connected to the strategic business plan activities, see figure 4.
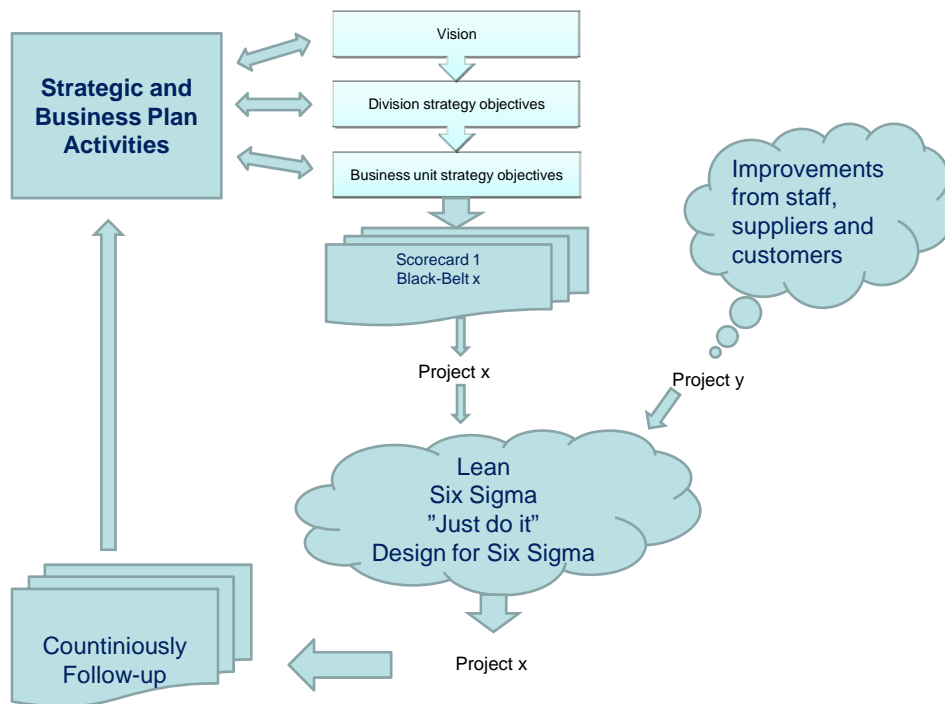
Figure 4   *The Six Sigma project is often initiated by breaking down vision, strategies and objectives. The improvement projects are a part of the strategic business plan activities.*

SKF, Alfa-Laval, Volvo and SKF have aligned Lean and Six Sigma, even if they have Lean, Kaizen and Six Sigma projects they make use of the Six Sigma philosophy and DMAIC methodology as a common platform in all projects.

If there is a crisis in SKF or in the supply/demand chain, some of the 250 Black-Belts could be applied to solve it, but a drawback in Six Sigma projects is that they take an average of 6 months to complete. On the other hand, Volvo cars and Ericsson have performed Six Sigma projects in less than two weeks.

Volvo has performed Six Sigma projects in five days through their suppliers. Even if the improvement projects were more of a qualitative nature (Kaizen project), the DMAIC was used. The performance and complexity of the projects were the same as ordinary Six Sigma project. Ericsson in Borås has performed two Six Sigma projects in three days. The preparation before starting the project was about 10 hours in 2 weeks, but it could have been in two days. Afterwards, a few hours were devoted to controlling the process, according to Anders Näslid, Master Black-Belt, see figure 5 below. The success story of these projects has escalated into an additional five Six Sigma projects, which have been planned with short notice. The following examples supported that if there is an internal or external disturbance to the supply chain the Black-Belts could be seen as a spare capacity, as a fire fighter.

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Preparation is the key to fast Six Sigma projects!

Six Sigma
Workshop
(3 days)

Define   Measure   Analyze   Improve   Control
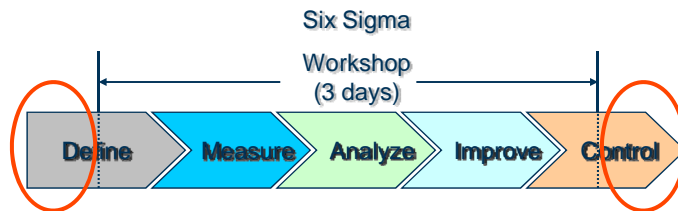
2007-11-05   ERICSSON

Figure 5   *By being prepared and having allocated staff and resources in three days, the lead-time for a Six Sigma project could be decreased pragmatically. Some vital staff members were forced to be available in short time if the project group should need them. The circle before and after the workshop explains that some hours were used before and after the workshop thus within the Six Sigma project*

Conclusion

It has been indicated that Lean Six Sigma companies are robust and have some degree of resilience. But it is important to re-invest in activities that make the supply chain more resilient. The savings generated from the Lean Six Sigma might be used for that purpose, especially re-investment in risk prevention and mitigation solutions. Different professions and staff from different companies could be represented in the same training *"wave"*, in order to create a risk management culture, common values, culture and rules, especially a culture that supports resilience. This can build bridges between departments, factories and, also, between suppliers and customers.

Other ways to be more resilient is to use statistical process charts to monitor risks. A standard common produced product could serve as a buffer if some risks occur, but it might be a better solution to strive for redundancies. This could be to have two suppliers, more machines etc. Sales and Operations Plans may be more structured and well worked-out i.e. using simulation, scenario events, understanding critical paths and declare to the suppliers how much has to be supplied each week as well as how much this amount could be changed from the target. Other things to do are to train more Black-Belts and Green-Belts in the focal company and the supply chain, especially Sales and Operation Plan staff. If there is an internal or external disturbance to the supply chain the Black-Belts could be called in to solve it. It has also been indicated that it is important to have and perform different performance and approaches of projects, but the Six Sigma road map may be used in all project models. It is important to have a project approach that takes a few days to finish. The right quality and resilience must be designed from the beginning. Integrating

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Six Sigma with suppliers and customers into designing products and processes together will be the next challenge with a view to resilience.

The postponement strategy and to give the finishing touch to the product just before delivery to the customers as well as to have suppliers of late refine parts in a near region and other logistics strategies are important to be robust and resilient.

Due to the fact that each staff member and manager sees risk through the lens of their own performance measures, it might be necessary to re-invest in some people or a department, which has an overall view of internal and/or external risks in the company supply chain. It might be a quality manager or a quality department.

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Defining Lean Production: Some conceptual and practical issues

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ABSTRACT

Purpose – This paper aims to investigate the definition of Lean Production and the methods and goals associated with the concept as well as how it differs from other popular management concepts.

Methodology/Approach – The paper is based on a review of the contemporary literature on Lean Production, both journal articles and books.

Findings – It is shown in the paper that there is no consensus on a definition of Lean Production between the examined authors. The authors also seem to have different opinions on which characteristics that should be associated with the concept. Overall it can be concluded that Lean Production is not clearly defined in the reviewed literature. This divergence can cause some confusion on a theoretical level, but is probably more problematic on a practical level when organizations aim to implement the concept. This paper argues that it is important for an organization to acknowledge the different variations, and to raise the awareness of the input in the implementation process. It is further argued that the organization should not accept any random variant of Lean, but make active choices and adapt the concept to suit the organization's needs. Through this process of adaptation, the organization will be able to increase the odds of performing a predictable and successful implementation.

Originality/Value – This paper provides a critical perspective on the discourse surrounding Lean Production, and gives an input to the discussion of the implementation of management models.

Keywords – Lean Production, Definition, Construct Validity, Total Quality Management

Paper type – Conceptual paper

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INTRODUCTION

When initiating research concerning the concept of Lean Production (LP) one line of questions naturally comes to mind: 'What *is* Lean? How is Lean defined? How does Lean relate to other management concepts? What does Lean have in common with other management concepts? What discriminates Lean from other management concepts?'

Seeking answers to these questions, will lead to the realization that they are exceedingly hard to find. It seems logical that a management concept as popular as Lean should have a clear and concise definition. Much disappointingly, the definition of Lean Production is highly elusive. Some authors have made attempts to define the concept (*e.g.* Lewis, 2000; Hines et al., 2004; Shah & Ward, 2007), while others have raised the question of whether the concept is clearly defined (*cf.* Dahlgaard & Dahlgaard-Park, 2006; Engström *et al*, 1996; Lewis, 2000).

A justified question is whether the convergent validity of Lean actually makes any difference – does it matter how we define Lean? There are various opinions on the effects of this.

The absence of a clear definition has a number of consequences for practitioners seeking to implement Lean as well as researchers trying to capture the essence of the concept. These issues have been addressed by a number of researchers. The lack of a definition will lead to communication difficulties (Dale & Plunkett, 1991 *in* Boaden, 1997). It will complicate education on the subject (Boaden, 1997). Researching the subject will be difficult (Godfrey et al, 1997; Parker, 2003) - although Boaden (1997) states that this is *not* essential. There will also be difficulties in defining overall goals of the concept (Andersson *et al*, 2006).

Parker (2003) states that the multitude of interpretations on what Lean really is makes it harder to make claims towards the effects of Lean, thus increasing the requirements that researchers specify exactly what they are researching. Karlsson & Åhlström (1996) point out that the lack of a precise definition also will lead to difficulties in determining whether changes made in an organization are consistent with LP or not, and consequently difficulties in evaluating the effectiveness of the concept itself.

PURPOSE OF THE ARTICLE

The main purpose of this article is to give a presentation of what Lean Production is. This will be done through a review of contemporary literature on Lean and summary of practices associated with Lean as well as the stated purpose of the concept. Based on this, an evaluation of the construct validity of Lean will be made.

The paper will conclude with a discussion of the practical implications of the construct validity of Lean.

RESEARCH APPROACH

Hackman & Wageman (1995) reviewed the TQM concept and raised the question of "whether there really is such a thing as TQM or whether it has become mainly a banner under which a potpourri of essentially unrelated organizational changes are undertaken". This is a valid question for any construct similar to TQM, and the concept of Lean Production is no exception. Following the reasoning of Hackman & Wageman, this question calls for the evaluation of the concept's convergent and

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discriminant validity. Hackman & Wageman (1995) describe the two kinds of validity as follows:

> Convergent validity reflects the degree to which [different] versions [of the concept] […] share a common set of assumptions and prescriptions. […] Discriminant validity refers to the degree to which [the concept] can be reliably distinguished from other strategies for organizational improvement. (Hackman & Wageman, 1995)

In other words, the discriminant validity tells us whether or not a concept carries any news value compared to other existing concepts, whereas the convergent validity, strictly speaking, tells us whether or not the concept itself really exists.

For this article, the two major citation databases ISI and Scopus have been searched for articles containing the terms "lean production" or "lean manufacturing" in the topic, abstract or keywords. The 20 most cited articles from each database were selected for further study.

Through reading these and other articles on the subject, the most influential books were identified. This list was verified through using the citation analysis software 'publish or perish'.

The reviewed literature will be compared by listing the characteristics of Lean presented by each author. The idea is that a method, tool or goal that is central to Lean will be mentioned by every author on the topic. The purpose or goal of Lean should logically be the same for all authors. Concurrence among the authors will signify a high convergent validity. If Lean passes this convergent validity criterion, an evaluation of the discriminant validity can be made, based on a comparison with TQM. Hackman & Wageman (1995) concluded that TQM passed the tests of both convergent and discriminant validity, making it a good concept to compare against Lean Production.

LITERATURE REVIEW

The two database searches produced a total of 37 articles, of which 12 of them contained presentations of techniques and/or overall goals associated with LP, thus contributing to a conceptual discussion.

The 12 articles that are deemed suitable for a further analysis are Krafcik (1988), Oliver et al. (1996), Sanchez et al. (2001), Lewis (2000), Mumford (1994), James-Moore & Gibbons (1997), MacDuffie et al. (1996), Dankbaar (1997), White et al. (2001), Hayes & Pisano (1994), Jagdev & Brown (1998) and Cusumano (1994).

A number of books turned up in the literature search. An investigation of the books' citation rankings led to a filtering process with 13 books remaining. These are Womack et al. (1990), Womack & Jones (2003), Bicheno (2004), Ohno (1988), Monden (1998), Liker (2004), Feld (2001), Dennis (2002), Schonberger (1982), Shingo (1984), Rother & Shook (1998), Jones & Womack (2002) and Smalley (2004).

The publications by the Lean Enterprise Institute (Rother & Shook, 1998; Jones & Womack, 2002; Smalley, 2004) are very specific on certain tools (mainly value stream mapping), and were not deemed suitable for a conceptual discussion about Lean in general.

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Table I on the next page is a presentation of the most frequently mentioned characteristics of Lean in the reviewed books. Characteristics that have been discussed by less than three authors have been excluded from the presentation. The characteristics in the table are sorted based on frequency of discussion in the reviewed literature.

Looking at the table reveals some interesting aspects about the ideas surrounding Lean. The only two characteristics that all authors discuss are 'setup time reduction' and 'continuous improvement', indicating that these are central to the concept. On the condition that pull production can be seen as a special case of Just-in-time production, all authors lift this characteristic as well. Failure prevention (poka yoke) and production leveling (heijunka) also seem to be central characteristics of Lean Production.

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	Womack & Jones (& Roos)	Liker	Bicheno	Dennis	Feld	Ohno	Monden	Schonberger	Shingo
Kaizen/Continuous improvement	X	X	X	X	X	X	X	X	X
Setup time reduction	X	X	X	X	X	X	X	X	X
Just in time production	X	X		X	X	X	X	X	X
Kanban/Pull system	X	X	X	X	X	X	X	X	
Poka yoke		X	X	X	X	X	X	X	X
Production leveling (Heijunka)	X	X	X	X	X	X	X		X
Standardized work		X	X	X	X	X	X	X	X
Visual control and management		X	X	X	X	X	X	X	X
5S/Housekeeping	X	X	X	X	(X)	X	X	X	
Andon	X	X			X	X	X	X	X
Small lot production		X	X		X	X	X	X	X
Time/Work studies	X	X	X	X	X	X	X		
Waste elimination	X	X	X	X		X		X	X
Inventory reduction	X	X		X		X	X	X	X
Supplier involvement	X	X	X	X	X		X		
Takted Production		X	X	X	X		X		X
TPM/Preventive mainenance		X	X	X	X	X		X	
Autonomation (Jidoka)		X		X			X	X	X
Statistical quality control (SQC)	X		X	NO!	X		X	X	
Teamwork	X	X		X	X	X			
Work force reduction				X		X	X	X	X
100% inspection		X		X				X	X
Layout adjustments				X			X	X	X
Policy deployment (Hoshin kanri)	X	X	X	X					
Improvement circles		X		X			X	X	
Root cause analysis (5 why)	X	X	X			X			
Value stream mapping/flowcharting	X	X	X	X					
Education/Cross training (OJT)		X			X			X	
Employee involvement	X	X		X			(X)		
Lead time reduction		X		X			X		
Multi manning	(X)					X	X		X
Process synchronization		X						X	X
Cellular manufacturing				X		X	(X)		
Goal	make products with fewer defects to precise customer desires	One-piece flow	Reduce waste and improve value	Customer focus (high quality, low cost, short time)	Robust production operation	Cost reduction	Eliminate waste and reduce costs	Improve quality and productivity	Cost reduction through waste elimination

Table I   A presentation of characteristics associated with Lean Production. The characteristics are sorted by accumulated frequency.

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ANALYSIS

CONVERGENT VALIDITY OF LEAN

The characteristics listed in Table 1 (previous page) have some relation to each other, motivating an affinity analysis. One way of grouping these characteristics is presented in Table 2 below.

Collective term	Specific characteristics
Just in Time practices (100 %)	Production leveling (heijunka) Pull system (kanban) Takted production Process synchronization
Resource reduction (100 %)	Small lot production Waste elimination Setup time reduction Lead time reduction Inventory reduction
Human relations management (78 %)	Team organization Cross training Employee involvement
Improvement strategies (100 %)	Improvement circles Continuous improvement (kaizen) Root cause analysis (5 why)
Defects control (100 %)	Autonomation (jidoka) Failure prevention (poka yoke) 100% inspection Line stop (Andon)
Supply chain management (78 %)	Value stream mapping/flowcharting Supplier involvement
Standardization (100 %)	Housekeeping (5S) Standardized work Visual control and management
Scientific management (100 %)	Policy deployment (hoshin kanri) Time/Work studies Multi manning Work force reduction Layout adjustments Cellular manufacturing
Bundled techniques (56%, 67%)	Statistical quality control (SQC) TPM/preventive maintenance

Table II   *A suggestion for a grouping of lean characteristics. The bracketed figures indicate the percentage of the authors that have discussed at least one of the characteristics in the group.*

Through grouping the characteristics a more homogenous image of the Lean characteristics arises. For all but three of the groups all authors have discussed at least one of the characteristics in the group. In the group labeled as *human resource management* none of the characteristics are discussed by authors Bicheno and Shingo. The authors Ohno and Schonberger have not discussed any of the characteristics in

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the group labeled as *supply chain management*. Furthermore, the *bundled techniques* have slightly lower figures. This indicates that the two groups *human relations management* and *supply chain management* are not *definable* characteristics of Lean, contrary to the findings of Shah & Ward (2003). However, the scores are quite high, indicating that they are important (although not vital) parts of the Lean concept.

Looking at the goals presented by the reviewed authors (Table 1) raises some questions towards the convergent validity of Lean. The general opinion that the purpose of Lean is to reduce waste does not seem to hold, although some authors (Bicheno, 2004; Monden, 1998; Shingo, 1984) argue for this. As discussed above there are two main traditions of Lean; "toolbox lean" and "lean thinking". This is also evident in the differences of goals in the reviewed literature. Generally speaking, there are two different types of goals, internally focused (Liker, 2004; Feld, 2001; Ohno, 1988; Monden, 1998; Schonberger, 1982; Shingo, 1984) and externally focused (Womack et al., 1990/Womack & Jones, 2003; Bicheno, 2004; Dennis, 2002; Schonberger, 1982). One could argue that the differences in formulation of purpose are very small thus making it a minor issue. However, an internally focused cost reduction initiative will differ substantially from an externally focused initiative to improve customer satisfaction.

The division of Lean Production in the two parts discussed above has led to discussions of which one is more correct. A common statement is that "Lean is more than a set of tools" (Bicheno, 2004), arguing for a more philosophical approach to Lean. However, there is also another position that argues for a more practical and project based approach to Lean and that "Lean is a collection of waste reduction tools". This kind of statement is hard to find explicitly in academic texts, but very common among certain practitioners.

Neither of the positions are more correct than the other, since Lean exists at both levels, having both strategic and operational dimensions (Hines et al., 2004). In addition, Lean can be seen as having both a philosophical as well as a practical orientation (Shah & Ward, 2007).

Through adapting and combining the four approaches to Lean suggested by Hines et al. (2004) and Shah & Ward (2007) respectively, Lean can be characterized in four different ways. The terms *practical* and *philosophical* are substituted by the terms *performative* and *ostensive*. The terms *operational* and *strategic* are substituted by the terms *discrete* and *continuous*.

	Discrete *(Operational)*	*Continuous* *(Strategic)*
Ostensive *(Philosophical)*	**Leanness**	**Lean thinking**
Performative *(Practical)*	**Toolbox Lean**	**Becoming Lean**

Table III   *An illustration of the four definable approaches to Lean Production. The bracketed terms are the ones suggested by Hines et al. (2004) and Shah & Ward (2007) respectively.*

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In the Table above four different approaches to Lean Production are presented. The term *ostensive* signifies a shift of focus from general philosophy towards issues that can only be defined by examples, whereas *performative* and *practical* focus on the things that are done. The term *discrete* signifies a focus on isolated events, such as individual improvement projects using the 'lean toolbox' (cf. Bicheno, 2004; Nicholas & Soni, 2006), or the final state of 'leanness' (cf. Krafcik, 1988). As a contrast, the term *continuous* signifies a process oriented perspective, focusing on the continuous efforts; the philosophy of 'lean thinking' or 'the Toyota way' (cf. Womack & Jones, 2003; Liker, 2004) or the process of 'becoming lean' (cf. Liker, 1998; Karlsson & Åhlström, 1996).

Although the score is not perfect, Lean seems to be a reasonably consistent concept comprising *Just in time practices, Resource reduction, Improvement strategies, defects control, standardization* and *scientific management* techniques. However, it is hard to formulate a clear definition that captures all the elements of Lean and integrates the various goals in the reviewed literature. In other words, Lean can be said to (barely) pass the convergent validity test, although there is no clear agreement among the authors as to the overall purpose of the concept.

DISCRIMINANT VALIDITY OF LEAN

So what is then the difference between TQM and Lean Production? In the following section Lean and TQM are compared based on the analysis made by Hackman & Wageman (1995). The discussion is done with three different aspects; *basic assumptions*, *change principles* and *interventions*.

Basic assumptions

Quality

In Lean, quality does not receive the same amount of attention as in the TQM literature. The main focus in the Lean literature is on Just-in-time (JIT) production. JIT is assumed to decrease total cost, as well as highlight problems. This is done through reducing the resources in the system, so that buffers do not cover up the problems that arise. In the short-term perspective, the reduction of resources implies a direct reduction of cost. In the long run, the reduction and subsequent elimination of buffers is assumed to highlight the problems that exist in production, thus being a vital source of continuous improvement (*e.g.* Shingo, 1984; Ohno, 1988; Krafcik, 1988).

A common opinion is that the purpose of Lean is waste elimination. The literature review does not show support for this being the very *purpose*, but waste elimination is definitely an important aspect of the concept. Some authors argue that waste is reduced in order to increase the value for the customer (*e.g.* Dennis, 2002; Bicheno, 2004), whereas others argue that it is a strategy for reducing cost (*e.g.* Ohno, 1988; Monden, 1998). Reducing waste is also a significant part of TQM, but under the banner of *poor-quality-costs* (*cf.* Hackman & Wageman, 1995; Sörqvist, 1998). A major difference between TQM and Lean in this aspect is the precision in defining waste. In the majority of the Lean literature, waste or *muda* is based on the seven forms[1] defined by Ohno (1988), whereas TQM has a very general definition of *poor-*

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[1] Transportation, Inventory, Motion, Waiting, Overproduction, Overprocessing, Defects

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quality-costs, including everything that could be eliminated through improvement (Sörqvist, 1998).

Employees and the quality of their work

One major critique of the Lean concept is that it is generally weak concerning the employees' perspective. The proponents of Lean Production usually have a strong instrumental and managerial perspective, discussing employees in terms of components in the production system (cf. Kamata, 1982; Berggren, 1992, 1993); .

The extensive discussion about *jidoka* and *poka yoke* in the Lean literature suggests that employees cannot be trusted to produce good quality, thus creating a necessity for removing the possibility of human error from the system.

Organizations as systems

One thing that Lean and TQM have in common is seeing the organization as a system (*cf. Womack & Jones, 2003; Bicheno, 2004)*. But there is a slight difference in perspective between the two concepts. Whereas TQM has a strong focus on the internal structure and integration of departments within the organization, Lean stresses a supply chain perspective, seeing the internal production operations as a part of a *value stream* from the sub-suppliers to the end customer (*e.g.* Rother & Shook, 1998; Jones & Womack, 2002).

Quality is the responsibility of senior management

This is another perspective that Lean and TQM share, but again with some differences. TQM-managers should create structures that support the employees in producing products of high quality (Deming, 1986; Hackman & Wageman, 1995). The idea is the same in Lean, but the rationale for doing this seems to be centered around eliminating the human factor from the system through *jidoka* and *poka yoke*. Using the terminology of McGregor, one could argue that TQM seems to be based on *theory Y*, whereas Lean seems to be based on *theory X* (*cf.* Ezzamel et al., 2001).

Change principles

Focus on processes

Within the Lean concept the term *value stream* is usually preferred (Womack & Jones, 2003). The term *process* is usually used at a lower level of abstraction that TQM theorists would call *sub-processes* or *activities* (*cf.* Riley, 1998). The conception that management should analyze and improve the processes and train the employees is also shared by the two concepts.

Management by fact

The literature on Lean does not really stress the *management by facts* explicitly. However, this is implicit in the description of Lean practices, many of which are analytical tools designed to help achieve JIT production. Although this is a shared perspective between Lean and TQM, there is a difference. Within TQM the analysis of variability through using statistical tools is a central concept (Hackman & Wageman, 1995). In the Lean tradition, this is not seen as equally important. In fact, some authors argue *against* the use of statistical tools for analyzing production performance, recommending alternative tools such as increased inspection and visualization of problems (*e.g.* Dennis, 2002; Liker, 2004).

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Learning and continuous improvement

In the words of Hackman and Wageman (1995) TQM is "pro-learning, with a vengeance" (p. 330). The learning aspects are not emphasized as much in literature on Lean. As discussed above, the Lean literature is generally weaker on the human behavior side, focusing more on instrumental techniques for improving system performance. There is a clear focus on continuous improvement, which implies that some form of learning is required. However, the question is *who* is learning. TQM is focused on stimulating creativity and individual efforts for improvement (Hackman & Wageman, 1995), whereas Lean places strong emphasis on the standardization of work and collective learning (Niepce & Molleman, 1998; Thompson & Wallace, 1996).

Interventions

Analysis of customer requirements

Customer focus is one of the hallmarks of TQM, where every improvement should be based on an investigation of the customer's requirements, whether the customer is internal or external. The Lean concept does not emphasize customer interests. Some authors argue that the very purpose of Lean is to please the customer (*e.g.* Dennis, 2002), but methods for analyzing customer requirements are extremely rare in the reviewed literature, suggesting this is not a typical Lean intervention.

Supplier partnerships

The suppliers are seen as important in both Lean and TQM. Both concept stress the point that long term partnerships should be made with suppliers and that improvements should be done in collaboration with them. Although this matter is not discussed by all authors in this analysis, the majority of them do (*cf.* Table 1).

Improvement teams

Quality circles have a central role in much of the TQM literature, and can be put to use in problem solving or improvement activities. In the Lean literature, Improvement teams are explicitly discussed by just about half of the reviewed authors. However, they are often implicated in discussions about improvement activities.

Scientific methods for performance measurement and improvement

Both TQM and Lean employ various scientific methods for analysis and evaluation of performance. However, these methods differ significantly, and the tools associated with one concept are generally not mentioned in literature on the other one. The purpose of measurements also differs. In TQM measurements are done in order to identify problems and to document improvement, whereas Lean theorists argue that measurements should be made for planning and synchronization purposes; e.g. for setting production rate (*cf.* Ohno, 1988; Bicheno, 2004).

Process management techniques

As discussed above, the term *process* is used in slightly different ways by authors on TQM and Lean. In the Lean literature, different techniques are presented for both overall process level and individual activities. At an organizational level *value stream mapping* (VSM) can be used for highlighting several kinds of problems in the

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processes (Rother & Shook, 1998). At a more operational level, different time/work study techniques are discussed, e.g. so-called *spaghetti charts* (*e.g.* Bicheno, 2004).

Lean and TQM – same but different

At a philosophical level, Lean and TQM have many ideas in common, in particular concerning continuous improvement and the systems perspective. However, at a more operational level, the two concepts differ significantly. The fundamental values of the two concepts are also quite different, especially regarding humanistic values.

CONCLUSIONS

There is no agreed upon definition of Lean that could be found in the reviewed literature, and the formulations of the overall purpose of the concept are divergent. Discomforting as this may seem for Lean proponents, there seems to be quite good agreement on the characteristics that define the concept, leading to the conclusion that the concept is defined in operational terms alone. Formulating a definition that captures all the dimensions of Lean is a formidable challenge.

According to Muffatto (1999) and Hines et al. (2004) Lean is constantly evolving, implying that any 'definition' of the concept will only be a 'still image' of a moving target, only being valid in a certain point in time. This may be an explanation to the apparent differences between authors on the subject. Based on this, it is hard not to raise the question of whether a consistent definition of Lean is possible to produce. Also, one can question whether a definition will be useful at all, regarding the ever changing nature of the type of constructs that management concepts such as TQM and Lean are. Nonetheless, attempts have been made in this article to present the essentials of Lean Production and convey its most salient philosophical elements, hopefully clearing up some of the confusion that surrounds the concept.

Lean is also significantly different from its closest relative TQM, leading to the conclusion that Lean is a management concept of its own. The conclusion from Shah & Ward (2003) that TQM and other bundles are parts of Lean is not supported by this study.

Womack et al. (1990) argue that the Lean principles are applicable to any industry. If this is correct, then the Japanese should logically have distributed the knowledge of these principles throughout all domestic Japanese industry. This does not seem to be the case. The only 'true' Lean producers in Japan are confined to the automobile industry, represented by *e.g.* Toyota, Honda and Mazda, whereas other areas of industry are performing at the same level as (or worse than) western competitors.[2] This was pointed out more than 20 years ago by Keys & Miller (1984), implying that the principles constituting LP have not received any wide-spread attention outside the auto-industry. Cooney (2002) argues that the possibility to become 'lean' (through JIT in particular) is highly dependent upon business conditions that are not always met, thus limiting the 'universality' of the concept.

When embarking on a journey towards Lean, it is important to acknowledge the different perspectives that the concept comprises. Raising the awareness of these differences may help make the message clearer and avoid conflicting opinions on which concept the organization is implementing. The obvious fallibility of the

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[2] Shu Yamada, University of Tsukuba – Seminar at Linköping University, 2007

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claimed universality of Lean should help motivate an adaptational approach to implementing the concept, aiming to find a production concept that agrees with the contextual factors and previous production practices that exist within the organization. Making active choices with regard to values and techniques should increase the odds of succeeding in the improvement of the production system.

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Critical Success Factors of Research and Education Process at Slovak Universities

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Abstract

Purpose – The paper intends to present and partially resolve the issue of a relatively short-aged higher education institution of regional importance, which is presented in the frame of the Slovak universities wide-ranging environment and the point of their complex accreditation.

Objectives – Objective of the paper is to explore the state and tendencies of developing the university environment, and also the influence of both external and internal factors that will impinge upon the University in the foreseeable period. The paper is intended not only for professionals involved in or that are in some other ways interested in improving research and educational processes of universities but also for those ones who are interested in attaining some information about the system of Slovak higher education institutions complex accreditation.

Methodology/approach – Used in the paper was a case study, which presented the groundwork method of researching elementary issues of developing the Alexander Dubcek University of Trencin (ADUT), built upon interviews with a selected sample of employees and randomly selected sample of the academic personnel and the student and with officers evaluating the Slovak universities within the European University Association. That was followed by the analysis of social, legal, economic, environmental, ethical, political, and technological aspects (SLEEPT) as a mnemonic tool to facilitate understanding of the Slovak universities' environment "big picture". Benchmarking was used as the method for comparing performance of Slovak universities from the point of the internal setting factors, and the criteria of complex accreditation, respectively. The method of pair comparison has been employed in the importance ranking while selecting critical factors of success.

Findings – Intricacy and inconsistency of some factors are due to not only the external environment but also to the university internal conditions. From amongst external factors we have explored social, legal, economical, ethical, political and technological environment. The internal environment has been considered from the point of complex accreditation attributes, and from the point of the EUA (European University Association) evaluating criteria. Based on the testimony of respondents, and in accordance with the university commonly shared values, its vision and new strategy established has been factors critical for successfulness of the young regional university. Considered as critical for success factors are: financing of university from budgetary and non-budgetary resources, ethics and corruption-free behaviour of individuals, quality and quantity of research and educational processes, critical interdisciplinary mass for research and education, and the university structure.

Research limitation/implication – Applicability of the model procedure in the form of SLEEPT external environment analysis and of the internal environment analysis based on a case study and of the complex accreditation and EUA evaluation criteria – at real-life strategic managing of universities.

Originality/value: The paper presents critical success factor of university using SLEEPT tool for external environment analysis and criteria of complex accreditation and EUA evaluation report.

Keywords – critical success factors, research and education process, SLEEPT analysis, university complex accreditation.

Paper type – Research paper.

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1   Introduction

Minister of Education of the Slovak Republic Ján Mikolaj intends to alter the entire manner in which are Universities being financed, and to push through their differentiation based on the quality level they will have attained in the frame of a complex accreditation. Differentiation, reflecting the output attained, will be effected by separation of schools into three categories, each of which will be financed differently:

- University type Higher Education Institutions (financial coefficient = 1.3)
- Higher Education Institutions (financial coefficient = 1.1)
- Specialized colleges (financial coefficient = 1.1)

Following complex accreditation of schools, which are going on during 2008 – 2009, he further intends to reassess the directives and to introduce a new methodology.

Normative financing is also objected by the European Association of Universities (EUA), which in its summary report (Jensen, Kralj, McQuillan, Reichert, 2007) presented results of evaluating of 24 Slovak universities. They blame us especially for they find allocation of finances according to the number of student improper.

EUA offered as to the universities so to the Ministry 28 main recommendations as to what should be modified in the higher education. Henrik Toft-Jensen from the EUA criticized that operating in Slovakia are too many universities (20 public universities, 3 state universities, 10 private universities), and that more than a single university are located in a town. EUA recommends that these should be amalgamated or their cooperation should be extended. As to the number of universities, Slovakia falls amongst European top ten.

Toft-Jensen further pointed out that Slovakia is allocating too little money to science and research. In his opinion the Slovak schools have a lot gaps to close if they wish to catch up with universities of the EU developed countries, and they differ in quality as well. If they want to proceed further ahead they should mutually cooperate more intensely. EUA perceives activities of academic senate negatively as well. "*Installed in the academic senates are often people acting as lecturers, and these are deciding on nominating or not nominating professors,*" remarked Prof. Bales president of Slovak rectors´ conference. The EUA report also warns that mobility of students and professors is not functional, and that university teachers speak very poor English.

Quality of schools is reflected also in the Shanghai list of 500 "top" universities globally – Slovak ones failed to qualify amongst them. Nonetheless, Slovakia managed to appear in another comparing list that included majority of schools worldwide. In the (Webometrics, 2008) list the Commenius University (UK) ranks 554th globally, and there is another Slovak university made to the first thousand where it holds position 704.

According to a two-years old OECD statistic, 84 percent of university graduates in working age are employed, and university students present 12% of the entire population. The labor market survey indicates that there is a shortage of technical graduates in the practice. (Pravda, 2007).

Universities, the budgets of which are currently "black boxes", need to define the full costs of their activities to justify the use of public and private funds, said Education Commissioner responsible for Education, Training, Culture and Youth Ján Figel, who believes universities should be paid "for what they do" (EuroActive, 2008).

2　Methodology

Used in the present paper was a case study, which presented the groundwork method of researching elementary issues of developing the Alexander Dubcek University of Trencin (ADUT), built upon interviews with a selected sample of employees (Chancellor, Vice-Chancellors, Bursar, study programs' guarantors, Chair of the Students' Parliament, and randomly selected sample of the academic personnel and the student) and with officers assessing the Slovak universities within the European University Association (EUA) projects: Institutional Evaluation Programme (Kralj, Emel, Jensen, Riegler, 2007), Institutional Diversity Study for Higher Education Institutions (Vlasceanu, Smith, 2008), Quality Assurance for the Higher Education Change Agenda "ACQUIN" (ZgodavovaLA, 2008).

That was followed by the analysis of social, legal, economic, environmental, ethical, political, and technological aspects (SLEEPT) as a mnemonic tool to facilitate understanding of the Slovak universities' environment "big picture".

Benchmarking was used as the method for comparing performance of Slovak universities from the point of the internal setting factors, and the criteria of complex accreditation, respectively.

The method of pair comparison has been employed in the importance ranking while selecting critical factors of success.

3　Alexander Dubcek University of Trencin in the Slovak University environment (A Case Study)

Alexander Dubcek University of Trencin (ADUT) was established on 1 July, 1997 as a national higher education institution and presents one of the "youngest" universities in Slovak republic. Trencin region was the last Slovak region that did not have a higher education institution, and besides the state-wise need to extend possibilities of university studies and of increasing the number of university students was the independent University forming necessitated especially by high concentration of mechanical, electrical and consumer goods industries, of significant "research – development – design" organizations, social, healthcare and cultural institutions. The other stimulus was relatively high potential of the young-ones qualified for university studies. Formed at establishing the University was four principal integral parts:

- Faculty of Special Technologies (FST)
- Faculty of Mechatronics (FM)
- Faculty of Industrial Technologies (FIT)
- Faculty of Socio-Economic Relations (FSER)

Formed later on, in 2002, was the Institute of Natural Sciences and Humanities (INSH) that was meeting selected university-wide educational and research expectations especially due to the existence of the Institution of Glass Research (IGR); still later on, in 2004, established was the Institute of Healthcare and Nursing (IHN).

Whereas in concern was a new university the very first complex accreditation was performed in 2002 in accordance with Act No. 131/2002 *Coll.* on Universities. After five years of operating, and considering the results attained at building of a new university, this was honored by renaming to the Trencin University of Alexander Dubcek in Trencin. In 2008 we are awaiting another complex accreditation any and all Slovakian public higher education

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institutions must pursuant to amended Act No. 131/2002 *Coll.* on universities and to the Slovak Government Edict No. 104/2003 *Coll.* on accreditation committees go through by not later than end of 2009.

Within preparations for the complex accreditation, rationalization of ADUT processes in accordance with reviewed vision on new policy and on quality assurance strategy utilized within which were especially the EUA report information commenced in 2008.

IHN attained the statute of Faculty of Healthcare (FH) already by the beginning of the year, and due to cumulative financial losses was INSH divided among other faculties.

From the academic year 2001 – 2002 till today the number of students has doubled.

Academic personnel segmented according to the qualifications (Figure 1).
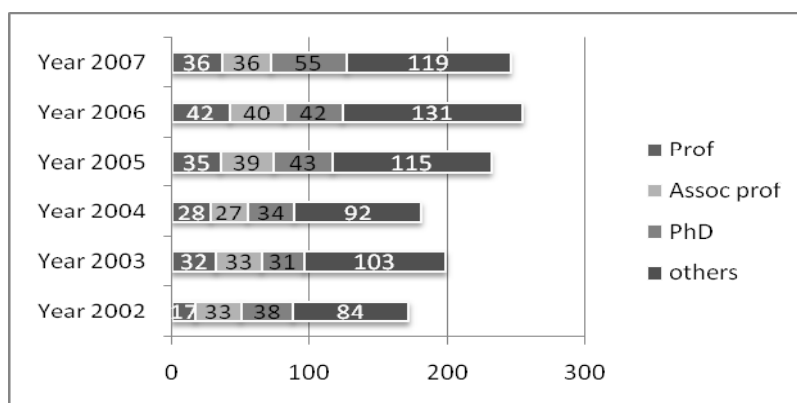
Fig. 1 Academic personnel segmented according to the qualifications

Outcomes according to criteria of complex accreditation
(according to the Decree of the SR Government No. 104/2003)

Criterion l: Results of assessing the level of the research activities. (Qualitatively ranked number of publication calculated per capita – per the number of academic staff).

> ADUT meet the requirements of being ranked to the group of "Higher Education Institutions" as a whole as three of five faculties gain results comparable to the national level. The Faculty of Industrial Technology met the requirements for worldwide level.

Criterion 2: The amount of funds allocated to universities for the research in the form of grants, project funds that are calculated per capita – per the number of associate professors, professors and researchers. (University category = 2,000 EUR, Higher Education Institution category – 1,300 EUR, Specialized colleges category = 1,000 EUR per capita – per the number of academic staff).

> ADUT is equal to the funds that meet the requirements for the "Higher Education Institutions".

Criterion 3: Number of PhD. graduates. (2 PhD graduates per capita – per the number of professors – per six years).

> ADUT meet the requirements of being ranked to the "Higher Education Institutions". (This criterion must be met only for ranking to the "University type of Higher Education Institutions". ADUT met the requirements only on one Faculty of Industrial Technology.

Criterion 4: Outputs of the research performed by students and by the doctoral study graduates.

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Outcomes of students and doctoral study graduates do not meet this criterion. (This criterion must be met only for ranking to the "University type of Higher Education Institutions". ADUT met the requirements only on one Faculty of Industrial Technology.

Criterion 5: Number of internal doctoral students taking PhD study programs recalculated evidentiary number of professors and associated professors.

ADUT do not meet the criterion needed for the ranking into the "University type of Higher Education Institutions"

Criterion 6: Number of students taking study programs of the first and second stage per the recalculated evidentiary number of university teacher. See formula (1) and (2).

ADUT do not meet the criterion needed for the ranking into the "University type of Higher Education Institutions ". The formula for recalculating the students/academic personnel is as follows:

$$\frac{\text{Number of daily study (regular)students} + 0.3 \times \text{ number of external students}}{\text{number of academic personnel with Professor, Associate Professor, PhD degrees}} \leq 20 \qquad (1)$$
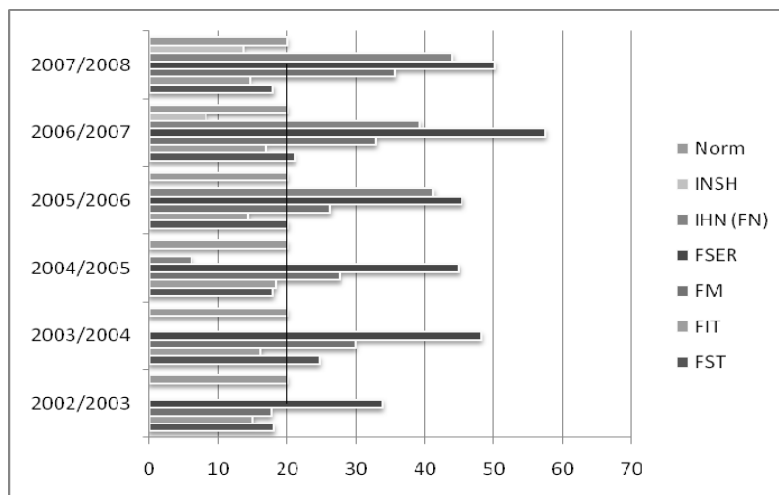
Fig. 2 Students vs. academic personnel ratio according to criteria of complex accreditation (University type of Higher Education Institutions)

At including into the "higher education institutions/colleges" category the formula reads:

$$\frac{\text{Number of internal students} + 0.3 \times \text{ number of external students}}{\text{number of all teachers (including without PhD.)}} \leq 25 \qquad (2)$$

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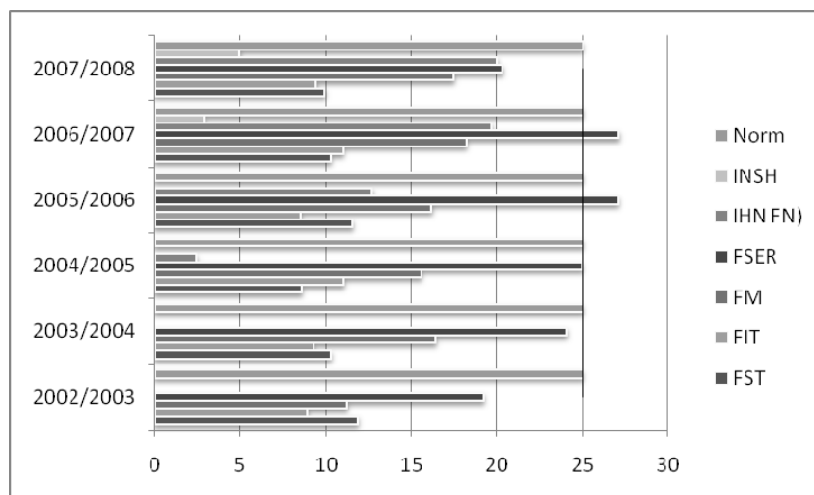
**Fig. 3 Students vs. academic personnel ratio according to criteria
of complex accreditation (Higher Education Institutions)**

Fields of research and study programs

Table I. Fields of research, study branches and study programs provided by ADUT

Fields of research [1]	Study branch [2]	Number of study programs
06 Social and behavioural sciences	3.1.6 Political science	BC = 1; MA = 1
08 Economy and management	3.3.5 Public administration and regional development	BC = 1
	3.3.14 Human resources and management of personnel	BC = 1
10 Environment and ecology	4.3.2 Environmental engineering	BC = 1
11 Metallurgical and fabrication sciences	5.2.26 Materials	BC = 2; MC = 1; PhD. = 1; I&H = 1
	5.2.57 Quality of production	BC = 1; MC = 1
12 Chemistry, chemical technologies and bio-technologies	5.2.18 Chemical technologies	BC = 2; MC = 1; PhD. = 1
	5.2.19 Inorganic technology and materials	
14 Mechanical engineering	5.2.1 Engineering	BC = 1; MC = 1
	5.2.2 Machine and equipment maintenance	BC = 1
	5.2.7. Engineering technology and materials	PhD = 1
	5.2.50. Production engineering	BC = 1; MC = 1
	5.2.51. Production machinery	BC = 1
16 Information sciences, automation and telecommunications	5.2.16 Mechatronics	BC = 2; MC = 1; PhD. = 1
18 Medical and pharmaceutical sciences	7.4.1 Nursing	BC = 1
	7.4.3 Laboratory examination methods in the healthcare	BC = 1

[1] List of the fields of research assessed within complex accreditation and of the respective study branches issued by the Slovak republic Ministry of education on FEB 28, 2006
[2] System of the Slovak republic study branches per the SR Ministry of Education Decree No. 2090/2002-sekr, as of DEC 16, 2002

4   Analysis of the ADUT position within the Slovak University environment

4.1 SLEEPLT analysis

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At creating a vision, policy and strategy of university or when evaluating existing ones it is important to 'scan' the broader external environment. This takes the adapted form of a SLEPT analysis, which we have tailored to SLEEPT (Social, Legal, Economic, Ethical, Political, and Technological) analysis of the influences on universities. In addition, it is also important to be aware of the actions of "competitors". These forces are continually in a state of change.

Table II. Broader external factors influencing Slovak universities

Factors	Description	Status and developmental trends
Social	The social factor relates to behaviour of students, employees and other concerned parties, and concerns changes in culture and lifestyles especially in relation to the demographic trend, age structure, health status of the population, educational and social mobility, to relation to work and to the way incomes are being utilized, and also to the free market, freedom of lifestyle, and to socio-cultural changes.	**Demographic trend** (+)↓ Inhabitants by age structure (–)↑ Migration of students (+)↑ Relation to work (+)↑ Free market (+)↑ Freedom of lifestyle (+)↑ Socio-cultural changes (+)↑ Utilization of life-long education (+) slowly ↑ Globalization (+)↑
Legal	The legal factor closely correlates with the social and economical factors, and includes changes in legislature resulting from social transformation and political right—left orientation of Parties in power.	The Labour Code [3] Act on Universities [4] Act on Accreditation [5] Act on ECTS system of credits [6] Possibility of paid off-campus form of the university study [7] Organizing the state support of research and development[8] Proceedings at awarding academic degrees[9] Process of attaining scientific and pedagogical degrees[10] Criteria for including a higher education institutions[11,12,13] among defined category **Criteria for habilitation (Assoc. Prof.) and professors nominating proceedings**[14] Proceedings at awarding academic degrees[15] Act on providing Information [16]
Economical	The economical factor and resulting changes tightly correlate with the legal and social situation that transpire in changes of the economical growth, interest rates, inflation, price changes, unemployment, costs of labour, globalization, technological changes of impact upon economy, and in changes resulting from change to euro.	Economical growth (+) slowly ↓ Salaries of graduates (+)↑ Interest rates (–)↓ Inflation (–)↓ Unemployment (–)↓ **Labour costs (–)↑** Technological changes (+)↑

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Ethical	The ethical factor profoundly correlates with the social factor and transpire through especially ethical and moral standards, as well as through democracy and corruption indexes.	Ethical code of the University employees [11] **Index of democracy (+) very slowly ↑** **Index of corruption (–) very slowly ↑**
Political	The political factor firmly correlates with the legal one, and is influencing universities especially through actions of the left or right –oriented political structures on the national and regional level and through their strategic decisions about investments into the higher education, especially then into the domain of research and development.	**Relative investments into universities (+) very slowly ↑** **Investments into research (+) ↓**
Technological	The technological factor is given by development of technologies, by the Internet, by communication savings, lowering of costs of maintenance, and by the influence of transfer of technologies, as well as by innovations.	Number of IT households (+)↑ Means of communication (+)↑ Transfer of technologies (+)↑ **Facilities of the university research labs (+) very slowly ↑** Facilities maintenance costs (–) ↓

[3] Act No. 311/2001 *Coll*. Labour Code – **amended in 2007**

[4] Act No. 131/2002 *Coll*. on Universities and on revision and extension of some acts per wording of later regulations – **amended in 2007**

[5] Decree of the SR Government No. 104/2003 *Coll.* on Accreditation committees – **amended in 2007**

[6] Slovak republic Ministry of Education Regulation No. 614/2002 *Coll*. on the study 'credit' system

[7] Slovak republic Governmental Regulation No. 475/2007 *Coll*. on specification of limit financial sums intended for ensuring study in study programs in their external (off-campus) form

[8] Act No. 172/2005 *Coll.* on organizing the state support of research and development

[9] Decree of the Slovak committee for academic degrees No. 65/1977 Coll. on proceedings at awarding academic degrees per wording of regulation No. 302/1990 Coll.

[10] Slovak republic Ministry of Education Regulation No. 6/2005 Coll. on the process of attaining scientific and pedagogical degrees or artistic and pedagogical degrees of Associate Professor and Professor

[11] Criteria for including a higher education institutions among "university-type higher education institutions"

[12] Criteria for including a higher education institutions among "higher education institutions" that are neither university-type nor specialised institutions

[13] Criteria for including a higher education institutions among "colleges type of higher education institutions"

[14] Criteria used at assessing fitness of the higher education institute to perform habilitation proceedings and professors nominating proceedings

[15] Act No. 211/2000 *Coll*. on free access to information

[16] Ethical code of employees of universities adopted by the Slovak Chancellors Conference Plenum on SEP 28, 2006

Indicators presented in Tab II. and intended to explore the status and tendencies of development of universities were identified whereas, in our opinion, they are in each case of decisive impact upon strategic decision-making of Slovak universities.

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The social environment is incongruous due to the fact that globalization, free market and free lifestyle offer extensive opportunities to the graduate for "making it" as in the country so abroad, though the demographic development and ageing of the population might significantly influence the future social environment. Fitness of Slovakia to utilize life-long education (Hrabinska, 2000) is significantly lagging behind the EU average (EuroActive, 2006).

The legal environment trend is in general positive as introduction of the central registry of the study program guarantors, university teachers, students and of scientific grants, as well as amendment of the Act on Universities and introduction of criteria for accreditation of universities and their study programs are all in support of transparency of research and educational processes in Slovakia.

The economic environment shows significantly positive trends despite existence of the US mortgage crisis, threat of the economy recession and anticipated deceleration of the economical growth. Growth of the graduate salaries has slowed down after 2004, though it still exhibits an ascending trend (Hunčík, 2006). Slovakia entering the EURO-zone holds promises of further stable growth of the Slovak economy (Konečná, Ševčovic, 2003) (Tözsér, 2004).

The university environment **ethical environment** presents one of the most delicate issues whereas from among 163 countries reviewed for the "democracy" index we are currently holding the 41st position (Kekic, 2007) and are characterized as the country with "democracy flaws"; considering the "corruption" index we are holding the 49th position (Transparency International, 2005) (Čaplánová, Szakadát, 2005). The indicator shows slightly positive trend though a significant threat of lobbying and non-transparent behaviour of individual persists.

The political environment tightly correlates with the legal frame, and it significantly influences especially the university financing strategies, especially then financing of science and research (The Lisbon Review, 2006). The situation is highly unfavourable in these indicators, whereas within the EU-27 we are rated 24th, i.e. 4th from the bottom (Eurostat, 2006). According to the key chart from the report (Jensen, Kralj, McQuillan, Reichert, 2007): Research and development intensity, 2005 and annual growth 2000 – 2005 Slovakia is the country with lowest average annual growth and research and development intensity.

The technological environment is characterized especially by indicators such as number of households with PC an Internet access, number of mobile phones and utilization of the Internet for phoning, but also equipment of research laboratories of universities. As to the first indicator we show 27% as compared with the 49% EU-27 average; in the second indicator it is 24% as compared with 47% EU-27 average, whilst the third one is also the most favourable for us, whereas here we are holding the 6th position within the EU-27 (Special Eurobarometer, 2007). Equipment of universities' laboratories is slightly improving and it is anticipated that it will improve significantly especially when considering the Slovak republic Governmental Regulation No. 766 of the 12th September 2007 on Long-range intent of the state scientific and technical policy till 2015. Nonetheless, whereas persistently missing in the years past were investments into the infrastructure, i.e. for procurement of quality instruments, devices or equipment of the university laboratories, the unfavourable situation is due to survive for many oncoming years.

Mr. Mikolaj, Education Minister, considers lack of finances donated to schools by the private sector for a problem as well. In his opinion, private entrepreneurs subsidize schools in an insufficient extent, whereas they arrive to profits of such investments. Poor facilities of schools are of impact to results of science and research, and hence of their utilization in the practice. According to the Euro Commissioner Jan Figel "univesities should be paid" for what

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they do". According to (Beri, 2008), for the future it would be important also that harmonized were individual fields of science with those preferred within the EU.

4.2 Benchmarking

Slovak universities should be as from 2010, and based on results of complex accreditation, separated into three differently financed categories.

Complex accreditation is supposed to —based on independent assessing— contribute to streamlining and increasing the quality of education provided by universities. Complex accreditation of the university activities presents a process within the frame of which the Accreditation Committee (AC) succinctly evaluates and assesses the educational, research, development, artistic and other creative activities of the university same as personal, technical, informational and other circumstances under which are these activities performed. Considered at assessing is the preceding 6-year period, and universities are obliged to submit their results attained in above mentioned 6 criterions.

More detailed data directly related to the outcomes of 6 criterions according to the complex accreditation will come available only by the end of 2009, when complexly accredited will have been all universities. However, produced at this point can be a referential benchmarking, based on a variety of statistical resources and according to the (ARRA, 2007).

When considering the number of students, in the 2006 – 2007 academic year ADUT ranked 14th from amongst 20 Slovak public universities; considering the academic personnel, it ranked 13th (eTrend, 2007).

According to (2), running in Slovakia are 9 super groups of study branches covering 362 study branches that are, according to [1], included into 24 fields of research. Studied in the aforesaid 362 study branches can be 7 200 separate study programs. Out of it presently, ADUT asserts itself in 8 fields of research and renders 18 study programs included in 8 study branches.

Scale of universities is in the category of technical faculty rather disgraceful for ADUT, whereas with the exception of FIT that holds 8th position, the other two faculties (FST and FM) are taking the last but one, i.e. 21st and the last, i.e. 22nd positions, respectively. Similarly, FSER ranks amongst the social science faculties the last, taking the 28th position, and thus ADUT as a whole holds the last, i.e. 20th position among public universities (ARRA, 2008).

Still worse, ADUT is continuously showing financial losses when majority of universities is profitable since 2006.

5   Critical success factors

Factor – variable (cause) of forming and changing properties and typical functions of the entity in the given environment and time. An entity is considered to be an issue that can be described individually.

Critical factor is a factor that conditions the process of necessary changes in properties and typical functions in the given environment and time.

Success in its general meaning is achieving something what you want, desire or intend (Encarta, 2008).

Universities are striving and desire for excellence. University excellence is according (Loukas, 2007) presupposes a smooth mantling of traditional academic values with values

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derived from the quality philosophy. Harmony, creation of stability (but not stagnation) in a dynamic self improving circle, constant monitoring, teamworking, continuous learning and personal advancement through reflection and conjecture, passion in the acquisition of knowledge and the advancement of science are factors that explain and describe "excellence" but also they constitute the teachings of quality management.

A success for the university ADUT would be achieving the level and the status of "university type higher education institution", achieving the state of students´ content and content of other parties involved in the process. A success would be represented by excellent results achieved in the processes of research and education. Regarding the results gained by the ADUT a success would also be forming stabile processes in line with the new visions, policy and strategies of the university.

Factors of ADUT success are according to (Kralj, Emel, Jensen, Riegler, 2007) and (Wagner, Zgodavova, Slabeycius, 2007) and (Mecar, et. all., 2008) are described in ten groups comprising 40 recommendations in ten groups.

On the external factors pinpointed by SLEEPT analysis and internal factors ascertained using the complex accreditation and EUA (European University Association) criteria we applied pair comparison, and have determined order of their seriousness. The pair comparison respondents were members of the Rectors´ board in the following set-up: rector, vice-rectors, bursar, and director of ITC centre, deans of faculties, representatives of student senate and representatives of academic senate. Based on the commonly shared values and upon the new vision determined were ADUT partial objectives and her critical successfulness factors (Table III.).

- Elimination of financial losses

- Improving the reputation

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Table III.

Objectives	Factors of external environment	Factors of internal environment		Critical Success Factors
		Accreditation	**EUA**	
To eliminate financial loss

To improve the reputation of ADUT

Increase in satisfaction and loyalty of both students and the employees | Social: Demographic trend

Legal: Criteria for habilitation (Assoc. Prof.) and professors nominating proceedings

Economic: Labour costs

Ethic: Democracy, Corruption

Political: Investments into universities and into research

Technology: Facilities of the university research labs | Results of assessing the level of the research activities

Amount of funds allocated to universities for the research

Number of PhD students

Number of PhD. graduates

Outputs of the research performed by students and PhD students

Number of students taking study doctoral programs per professors and associated professors

Number of students taking study programs per academic staff | Vision and mission

Governance and Management

Funding

Human recourses

Research

Service to society, R&D, knowledge transfer

Education

Students

Internationalisation

Quality development and management | **Funding:** To build structures which will secure critical interdisciplinary mass;

To change the structure of faculties and the design of study programmes;

To select assign the priorities in the field of education and research;

To reduce the number of direct contact lessons.

Ethics: To enhance ethics, visibility, competitiveness and standing, both nationally as well as internationally values.

Students: To monitor and inform students about the decisions at an early stage to encourage students to be interested in the university life.

Education: Increasing the number of PhD study programmes and students; decrease number of BC study programmes.

Quality: Development of an university-wide transparent system of quality management and its implementation;

Provide immediate feedback to students on the results of course evaluations and follow-up actions;

Integration of good international practices. |

6 ADUT vision and strategy

The existing strategic management of Slovak universities has been principally oriented to the quantitative side of the higher education institutions' development. In the oncoming period emphasis will be put on quality of the university research and education (Mikolaj, 2008).

Basis of the newly proposed vision has been the study prepared as a supporting document for EUA international evaluation (Wagner, Zgodavová, Slabeycius, 2007), and recommendations of the evaluating team (Kralj, Emel, Jensen, Riegler, 2007).

A new values and vision, being prepared by the new ADUT management, reads (Mecar *et al.*, 2008):

Values: *ethics, creativity, professionalism, teamwork*

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Vision: "*...to become a sought-after university type higher education institution in Slovakia at the beginning, and to gradually strive for attaining the level of a renowned and acknowledged university within EU* ".

We take long-lasting thematic, theoretical and methodological affinities of scientific and educational processes of the ADUT for the prerequisite that is impinged upon by ethical and non-corrupt behaviour of individuals, stabile guaranteeing of study programmes, and to these related fields of research in harmony with priorities of the EU in the field of research.

From the past studies and analyses it results that ADUT should, on the university level, adopt the "deceleration strategy", focused upon resolving the weak links and ineffective processes that bring about decrease of efficiency and deepening of financial losses. In this way she would be able to boost up her resources and capacities and to get prepared for the competitive battle of Slovak universities, and also to make it also in the international framework.

From the view of **change of culture** it is necessary to elaborate a detailed analysis of culture of especially those parts that are to be changed, and also to explain to the entire academia and the rest of employees that survival of the ADUT is jeopardised, to elect new leaders with fresh visions, initiate reorganisation, elaborate new procedures and "rituals" that would incorporate new visions, and to modify selection and socialising processes, the remuneration system, and to focus upon supporting new, specially on the student oriented values.

From the point of **organisational structure** it is necessary to perform analysis of fields of force, which would result in integration of three technical faculties into one, technically oriented faculty, whereas such a solution would be from the perspective of the number of results attained in the field of science and submitted at complex accreditation the most effective one. Attained at implementing such a solution would be also balancing of the number of students taking individual study programmes, and accordingly also gradual reducing of financial losses.

From the point of effectiveness in the **field of science** it is necessary to establish agreed priority areas as a basis for enhancing international visibility, reputation and excellence and to invest in these few priority areas and to motivate academic staff to seek publication of their research results in referenced journals.

From the point of performance in the **study programmes domain** it would be beneficial to redesign study programmes so that these would include contemporary, creative forms and methods of tuition, and also transmissibility of credits in accordance with ECTS, and that the methods were the practice demand oriented.

7   Summary

Addressed and partially resolved in the paper, with reference to by the Education Minister declared strategy of Slovak universities quality, are critical processes and critical for success factors, as well as orientation strategy of ADUT developed on the basis of long-term thematic, theoretical and methodological affinity of scientific, educational and entrepreneurial processes.

From the external environment the processes are influenced by decreasing demographic development, observance of criteria for habilitation and professors nominating proceedings, by inadequate democracy index attained, and by relatively pronounced corruption index of Slovakia as a whole, and moreover by minimal investments into universities, science and research.

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From the internal environment of concern are especially attainment of positive financial standing, modification of the organizational structure, ethical and non-corrupt behaviour of individuals, stabilized guaranteeing of study programmes a their related fields of research that would be brought in harmony with EU prioritised researches, favourable accreditation conditions as to the required "students — academic staff" ration, research results in group B – internationally acknowledged quality, and change of the university organizational structure.

Acknowledgments

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COULD UNIVERSITIES SUPPORT AND STIMULATE THE NEW ENTREPRENEURSHIP? THE UNIVERSITY OF FLORENCE CASE

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ABSTRACT

Purpose, originality and value of paper

In this paper we examine the links between universities and new entrepreneurship, paying particular attention to the higher education programs and its critical role in the process of new business creation by stimulating the entrepreneurial aspirations of young students and supporting the potential entrepreneurs in developing personal capabilities, skills and competences.

In term of content, we argue that universities in order to support new entrepreneurship can

- offer education and training activities and scientific production;
- support spin-offs and incubation activities transferring technology and patenting;
- promote stable relationships and fruitful partnerships with entrepreneurs and capitalists.

In fact, we believe the University with high quality teaching and scientific production can, first of all, be potential engines for the economic and entrepreneurial development of a country. Second, spin off and incubation activities can aid future entrepreneurs in the creation of a start-up facilitating the access to material, financial and relational resources. Finally, we believe that university can educate potential entrepreneurs transferring more codified knowledge into marketing, administrative, financial, technological and other areas.

Methodology and research implication

This paper focuses on the following research questions:

1. How can universities activities encourage an entrepreneurial thinking to be applied by students in start-ups?

2. How can universities activities educate potential entrepreneurs to transfer skills and competences acquired from the higher education programs to the new businesses start-ups?

3. Can higher education programs support collaboration between universities and entrepreneurship and aid future entrepreneurs in the creation of a start-up?

A literature review on new business creation, and relationships between higher education and entrepreneurial activities will be provided. We will present the case of University of Florence and its specific entrepreneurial activities and programs for undergraduate and graduate students.

The MAIR model (Motivation and Confidence, Abilities & Skills Development, Ideas and Resources) will be used to classify the activities and underline the special challenges of entrepreneurship education and the role of higher education in an entrepreneurial process.

The structure of this paper is the following: first, we present the research questions and the methodology adopted, then we discuss a specific case study (University of Florence) and we propose an application of an interpretive model (MAIR Model). Finally, we draw some conclusions and future research proposals.

Paper type: Case Study

Keywords:

University, higher education, new entrepreneurship, start-up, network, and social capital

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1. INTRODUCTION

The creation of a new firm is the result of a complex process involving the personal characteristics of the potential entrepreneur and an adequate combination of vocation, capabilities, and material and immaterial resources. Therefore, during the process, it is necessary to pay particular attention to the creation, setting-up and integration of the different skills, knowledge and know-how that potential entrepreneurs need to have in order to successfully start a new venture. Recently, the new business start-ups studies are focusing on the role that Universities and entrepreneurial centers, through its research and education activities, can and should play in sustaining and stimulating the development of knowledge and managerial competencies (Carlsson, 2005, Vallini e Simoni 2006).

In particular we stress the role that Universities can play in supporting and stimulating both internal and external factors (Sorrentino, 2003) that seem to influence the success of a start up:

- offering higher education programs and entrepreneurial and business activities,
- transferring technology, and
- providing services to start-up companies.

Recently, more and more universities have been integrating entrepreneurial and business activities into their courses and programs, which stimulate 'awareness' of entrepreneurship and which allow students to develop the basic skills and abilities needed for any entrepreneurial process (Finkle and Deeds 2001, Garavan and ÒCinneide 2003, Katz 2003, Frank 2005, Vallini and Simoni 2006). In the USA this phenomenon is firmly established, beginning in the early 30s at Harvard University and then spreading substantially to other campuses in the early 60s (Ivancevich 1991). Equally, in Italy, since the last fifteen years, many Universities started to offer similar activities and programs in order to support new entrepreneurs. In fact, as in the USA, at the present in Italy higher education programs and entreprenuerial activities promoted by Universities generally include different management courses, orientation meetings with students, internships and work experiences within companies to facilitate and reinforce the student's knowledge and capabilities. Moreover, there are a large number of partnerships with incubators and science parks for transferring the results of the scientific research and facilitating the high tech start-ups.

Stemming from the above observations, the purpose of our study, is to analyze the relationship between universities and new entrepreneurship, paying particular attention to the role that higher education programs and entrepreneurial activities can play within it. In this paper "higher education programs" is intended as the process, or series of activities, that allows an individual to develop knowledge, skills and capacities and those abilities needed to evaluate and solve specific entrepreneurial problems (Hynes, 1996).

Specifically, we discuss the case of University of Florence (Italy), that is an institution that offers one of the most well-rounded programs in the field of entrepreneurship and general management teaching with a large combination of undergraduate programs and a specific post-graduate program (Business Management).

University of Florence could be also considered an important engine for economic development as well as a center for the diffusion of entrepreneurship. In fact, in the last years it implemented finalized entrepreneurial activities and services to university spin-offs (e.g. a new laison office and an incubator located in the scientific campus) to facilitate the communication and dissemination of the scientific results.

The structure of this paper is the following: first, we present the research questions and the methodology adopted, then we discuss a specific case study (University of Florence) and we propose an application of an interpretive model (MAIR Model). Finally, we draw some conclusions and future research proposals.

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2. THEORETICAL FRAMEWORK, ASSUMPTIONS AND METHODOLOGY

Higher education programs are becoming increasingly more strictly related to the need to spread knowledge and know-how as a means for training new entrepreneurs and, consequently, for creating new entrepreneurship. It is precisely from this standpoint that business and entrepreneurial programs promoted by universities may become a strategic factor for generating new entrepreneurship, for the qualification and competitiveness of new ventures and for the developing of human resources of the highest level.

In Italy, the management, organization and promotion of educational, training and research activities dealing with entrepreneurship is, typically, carried out by the Faculties of Economic, which can be considered the hubs for entrepreneurial activities and the main starting point for all the other entrepreneurial higher education activities promoted by the universities.

We may then point out that the promotion and setting-up of these programs allows future entrepreneurs to find themselves within a system of networks which:
- legitimates and supports their entrepreneurial decisions (through *legitimation networks*) creating a climate of shared values having a substantial influence on entrepreneurial decisions,
- increases the possibility to evaluate and choose market opportunities (*opportunity networks*),
- provides access to information and material and intangible resources (*resource networks*).

Having access to such networks can therefore be positively linked to the creation of new firms and to the possibility to achieve good performance in their first years of life (Aldrich *et al.* 1986, Naphiet and Ghoshal 1998, Liao and Welsch 2005). On one hand, the networks legitimate, encourage and stimulate the processes of new business creation, and, on the other hand, they facilitate the access to pivotal resources and information needed for the successful start-up.

In term of content, we argue that universities can activate and stimulate the above-mentioned system of networks
- offering education and training activities and scientific production,
- supporting spin-offs and incubation activities transferring technology and patenting,
- promoting stable relationships and fruitful partnerships with entrepreneurs and capitalists.

In fact, Universities with high quality teaching and scientific production can, first of all, be potential engines for the economic and entrepreneurial development of a country. Second, spin off and incubation activities can aid future entrepreneurs in the creation of a start-up facilitating the access to material, financial and relational resources. Finally, Universities can educate potential entrepreneurs transferring more codified knowledge into marketing, administrative, financial, technological and other areas.

On the basis of those considerations our work is based on three *assumptions*:
1. universities, with high quality teaching and scientific production, are potential engines for the economic and entrepreneurial development of a country,
2. higher education programs and entrepreneurial activities can support collaboration between universities and entrepreneurship and aid future entrepreneurs in the creation of a start-up
3. higher education programs are strictly related to entrepreneurial competencies and to the consequential success rate of start-up companies.

The *research questions* that we aim to evaluate are:
1. How can universities activities encourage an entrepreneurial thinking to be applied by students in start-ups?
2. How can universities activities educate potential entrepreneurs to transfer skills and competences acquired from the higher education programs to the new businesses start-ups?

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3. Can higher education programs support collaboration between universities and entrepreneurship and aid future entrepreneurs in the creation of a start-up?

We assume the *research perspective* of potential entrepreneurs interested benefiting from relationships, resources and abilities developed through higher education programs.

We adopt a *descriptive case study methodology* (Yin 1989 and 1993). We selected University of Florence as it widely considered as an exemplary case and, as such it can be used to interpret, with an exploratory approach, the phenomenon under study. We used multiple sources of evidence*,* such as interviews, direct observations, physical evidence, analysis of corporate balance sheets, documents, web sites and secondary data collected from newspapers, magazines and trade journals.

The *unit of analysis* is the activities and programs promoted by University of Florence and their relationship with the new business creation process. For the selection of these specific activities we used a theoretical model: the MAIR model (Motivation, Abilities and Skills, Ideas, and Resources) (Hartshon 1998). It was previously applied in 2004 by NCGE (National Council for Graduate Entrepreneurship) to monitor the support offered to students at the affiliated universities (figure 1). As result of the application of this model, we carried out an analysis on the impact of higher education programs and entrepreneurial activities on motivation, knowledge, opportunities, resources, and performance and we tried to underline the role of these programs in an entrepreneurial process.

Figure 1: MAIR Model and entrepreneurial activities

MOTIVATION and CONFIDENCE	ABILITIES and SKILLS DEVELOPMENT	IDEAS	RESOURCES
Role Model and Case studies	Courses and classes	Idea Workshops	Enterprise learning
Networking opportunities	Conferences, worksops and talks	Networking opportunities	Techonology Transfer Activity
Enterprise forum and clubs	Works Experiences and stages	Idea concept banks	Incubation
Enterprise Events and Awards	Entrepreneurial Summer School	Research idea prototyping	Funding
Mentoring	Business Plan Competition	Business Concept Competition	Central support union
		Idea Workshops	Spin off activities

Source: authors' adaptation from NCGE (2004)

3. A THEORETICAL ACADEMIC CASE: THE UNIVERSITY OF FLORENCE

University of Florence is a public university located in the center of Italy. At present, the research and education activities are powered by 12 Faculties and 70 departments. On the academic year 2006-2007, more than 8450 students enrolled at the University of Florence (1115 the Faculty of Economic). Of the 2300 faculty members, 832 are full professor, 738 associate professor and 737 researchers.

Table I: University of Florence a la glance

UNIVERSITY MEMBERS	832 Full Professors
	738 Associate Professors
	737 Researchers
NUMBERS OF STUDENTS ENROLLED 2006-2007	8461
FACULTIES	12
DEPARTMENTS	70
SCIENTIFIC AREAS	5
INTERDISCIPLINARY CENTERS	13
CENTERS OF STUDY	16
INTERDISCIPLINARY CENTERS	13
RESEARCHES CENTERS	10
OTHER FACILITIES	Library
	Associations
	Interdisciplinary center
	Info points

Source: internal report Academic year 2006-2007

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Since the last years one of the most important objective of University of Florence is to lead the global advancement of entrepreneurship education and practice through the development of academic, research, and outreach initiatives that can inspire entrepreneurial thinking and cultivate entrepreneurial leadership in all organization and society.

In order to support entrepreneurship, the University implemented finalized education activities, services to university spin-offs, and patent licensing. Moreover, the close collaboration with the local and regional government, the Chamber of Commerce of Florence and with a large number of firms can provide further benefits for the potential entrepreneur, including the possibility of

- attending and enrolling on significant extra curricula activities (e.g. professionalizing programs, meetings and workshops),
- building networks and contacts with these institutions that can enable them to interact directly with other entrepreneurs, and, consequently, to acquire the needed link between people, ideas and resources that all entrepreneurial processes require and,
- exposing them to a global network and a system of alliances made up of relations, contacts, and exchanges of ideas to bring students closer to entrepreneurs.

Using the MAIR Model (figure 2), we categorized and divided the entrepreneurial activities promoted by University of Florence, that can

- motivate potential entrepreneurs (legitimation networks) by influencing personal and motivational variables (variable MAIR: motivation and confidence) (e.g. meetings, conferences, study and work groups, promotion of spin off activities),
- create a network that connects students, professors and the business world, motivating and legitimating (legitimation networks) the entrepreneurial activity (variable MAIR: motivation and confidence),
- increase and develop an entrepreneurial climate and culture where students can work and mature academically and professionally (legitimation networks),
- share entrepreneurial abilities, competences, skills and capacities (variable MAIR: Abilities and Skills Development),
- assist and facilitate the starting and development of new entrepreneurial ideas (variable MAIR Ideas) (opportunities and resource networks), and
- facilitate the access to material and financial resources (variable MAIR: Resources) (resource networks) (e.g. Incubator, spin off activities, technology transfer, work experiences, and stages)

Figure 2: MAIR Model and entrepreneurial activities at University of Florence

MOTIVATION and CONFIDENCE	ABILITIES and SKILLS DEVELOPMENT	IDEAS	RESOURCES
Professionalizing programs (Experts in design and start-up of new companies)	Education and training activities	Conferences and worksops	Incubator
Post degree orientation	Post graduate program (Business Management)	Professionalizing programs (Experts in design and start-up of new companies)	Spin offs activities
Erasmus and socrates programs	Conferences and worksops	Post graduate program (Business Management)	Laison office
Possibility to enter into the incubator system	Professionalizing programs (Experts in design and start-up of new companies)	Outreach activities	Contact with consulting firms
			Outreach activities

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Referring the academic programs (*Education and training activities, courses and programs*) the University of Florence offers interdisciplinary curricula and co-curricula for both its undergraduate and graduate students focusing on the development of entrepreneurial competence, skills and capabilities. Alongside its academic programs, for years University of Florence has been involved in intensive research activity dealing in entrepreneurship (*Research Publications, Conferences and workshops*). Further, in order to establish a series of relationships and contacts between universities, companies and other institutions and to create and proliferate an entrepreneurial climate and culture (essential element to stimulate the creation and starting of the process of new entrepreneurship) University of Florence is one of the most active universities in the promotion of outreach programs (*Special programs, Erasmus and Socrates programs, Professionalizing programs*).

In 2002, it signed an agreement with other Italian universities (*NetVal: Network per la valorizzazione della ricerca universitaria – Network for the valorization of the academic research*) to homogenize the criteria that lead the decisions on patenting, spin-offs creation, and technology transferring in order to identify conditions that could increase the economic impact of the research results, through licensing, spinning-off and incubators (*Incubator system, liason office*) (Piccaluga, 2005, Vallini and Simoni, 2006).

The figure 3 sums up the entrepreneurial activities promoted by University of Florence.

Figure 3: The entrepreneurial activities of University of Florence
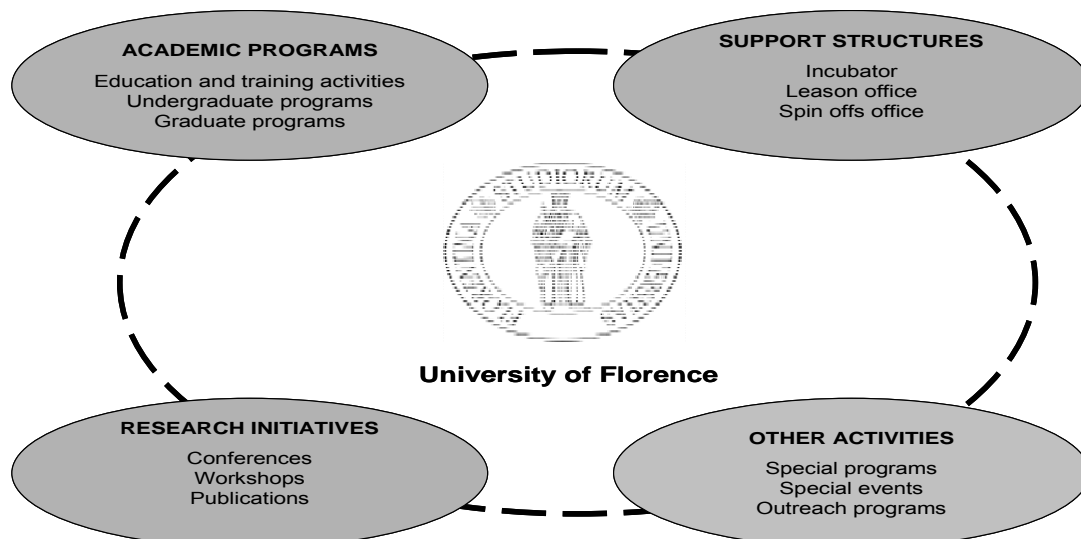
Academic Programs

The education and training activities are set up in 5 different programs: Undergraduate Programs, Graduate Programs; Post graduate programs, Ph.D. and Professionalizing programs. Every program is oriented to an interdisciplinary and modular approach characterized by lessons on theory, case studies, simulations and integrative and supplementary projects.

The *undergraduate curricula* integrates core competencies, key business disciplines, and the social studies into a large number of programs based on courses in accounting, management, marketing and finance.

The *graduate programs* promoted by economics and business school cultivate an entrepreneurial thinking that students can apply in start-up ventures and the corporate environment. In particular we'd like to stress the graduate program Business Management launched on the academic year 2003-2004. It's promoted by Business College (Faculty of Economic) and is set-up in 8 courses that adopt the entrepreneur's perspective. The program

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focuses on the technical tools needed on the management of firm development processes (Corporate Governance and Strategic Management) starting from the early stage (Start-up) and finishing with the process of management recovering and turnaround strategy (turnaround management). Besides, it takes into consideration, also, the consulting tools (Management Consulting) and the methodologies for analyzing sectors that can be useful for an entrepreneur in all of a firm lifecycle (Industries analysis and Operation Management). Business Management turned out to be a unique case in Italy for its original perspective and the most successful post-graduate program of the University of Florence in terms of number of students (Vallini and Simoni, 2006).

The scheme below (table II) catalogs the post graduate programs focusing on the activities promoted by Economics and Business school. In the right side is detailed the Business Management program.

Table II: Post graduate program and Business Management program at University of Florence

POST GRADUATE PROGRAMS		BUSINESS MANAGEMENT		
Economics and Business School				
Business Management		Corporate Governance		
Marketing		Strategic Management and Value		
Advanced accounting		Start-up		
Management consulting		Management of innovation		
Advanced development economics		Management Consulting		
Economic and social sciences		Tournaround Management		
Finance		Industries Analysis		
Business Legislation		Operation Management		
Advanced tourism management				
Population and society				
Statistics for firms			2003-2004	2004-2005	2005-2006
Human resources management		N. students	34	64	103
Actuarial sciences				
Political economics				
Agriculture School				
Architecture School				
Pharmacy School				
Law School				
Engeneering School				
Literature and Philosophy School				
Medical School				
Education School				
Mathematics, Physics, and Natural Sciences				
Political Sciences School				
Joint programs				
Literature and Philosophy School & Mathematics, Physics, and Natural Sciences				
Education School & Literature and Philosophy School				
Education School & Political Science School				

The programs for undergraduate and graduate students are also supplemented by *post-graduate programs* (Master and Ph.d. programs) and by *professionalizing programs* made up with through a partnering, collaborating and integration approach between the university and many diversified partners that all share the same strategic goal.

On the academic year 2004-2005 the Business School started a program for undergraduate students, financed by the European Union and with the support of local companies and trade associations, to create *"Experts in design and start-up of new companies"*. The curriculum

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consists of a total of 810 hours (560 class hours and 250 hours of internship) articulated in an 18 months calendar and it is an integrative program for the undergraduate students.

The innovative integration of diversified teaching methods and learning models is particularly evident in this program, providing a series of seminars with entrepreneurs, marketing managers, communication consultants to pass to the students a system of knowledge and competencies related to all of the phases of the process of new business creation. Moreover the further application of the competencies developed through the lessons and the laboratory activities takes place during the internships. The educational strategy is based on a learning process that take the students from frontal lessons to technical-operative teaching through laboratory activities, to a final experimentation of the acquired competencies into firms (Vallini and Simoni, 2006).

Research initiatives

An integral part of the higher education process is the promotion of research and conference activities needed for the communication of newly developed know-how or innovative ideas through the organization of conferences, workshops and seminars for the discussion of studies and researches of scientific interest. This type of commitment is a fundamental source of new ideas (MAIR Ideas variable) and a direct result of the exchange of projects, study results and research. Moreover, this offers an opportunity for reciprocal learning-teaching, and for the adoption and use of innovations so that a virtuous circle of ideas and learning is the result.

For istance, this year, two different international conferences are taking place at University of Florence: the 11th Toulone-Verona conference on Quality Services and the 8th Global Conference on business and economic.

The research activities is also supported by the *entrepreneurial center Roberto Fazzi "Imprenditorialità e governo di impresa"*. It was established in 2004 and is based on the commitment of a group of researchers to study and analyze the management issues adopting the entrepreneur as the object of analysis. In January 2006, the entrepreneurial center Roberto Fazzi and the Faculty of Economics organized an international workshop (*Entrepreneurship and firm: the role of entrepreneur*) to discuss and debate about entrepreneur and entrepreneurship. Academic leaders from around the world are invited to participate in the research conference and the papers presented are published in a special issue of Sinergie, an Italian management review.

Other Activities

Finally, students may also take part in co-curricular programs (Abilities and Skills variable of the MAIR model). University of Florence offers the possibility to join special programs to support actions in the fields of mobility (period of study or placement abroad), European projects and networks providing education and training activities at local, regional and national levels, giving the chance to live and study in a foreign country, and increasing placements in enterprises by the end of the program.

For example, the *Erasmus Program* is an EU co-operation and mobility program in the field of higher education which promotes the student and staff mobility and European co-operation involving higher education institutions and other key players in the knowledge-based economy. University of Florence, in cooperation with associations, research centers, and local government, carries out also other transversal programs (e.g. *Socrates Program*, and *Leonardo da Vinci Program*) in order to stimulate the creation of an international network and to increase the dissemination and exploitation of project results.

Alongside these programs, for years University of Florence has been involved in intensive *post degree orientation* activities such as work experiences and stages. In these activities, the Faculty

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of Economic plays an important role to ensure that the trained tutors, the academics and the stage committees do their best to connect the students with the business world.

Support Structures

Referring to the MAIR model variable *Resource*, in 2004 University of Florence participated, together with the local and regional government and the Chamber of Commerce of Florence, to the creation of an incubator located in the scientific campus for transferring the results of the scientific research and facilitating the high-tech start-ups.

The 3.000 square meter incubator, that at the present is assisting 15 start-up companies (see table III), provides below-market rent on office space and shared services such as teleconferencing equipment, a conference room, and secretarial services. Marketing, legal, and accounting services also may be provided.

Table III: Start-up companies at Incubator of Florence

1	BIZWORK	ICT and software
2	COMM.IT	ICT and software
3	EN-ECO ENERGY FOR ECOLOGY	Renewable energy sources
4	ECO TECHNOLOGY	Water Treatment & Commercial Water Purification Systems
5	EONTYCH	Biotech and Biomedical
6	DFL S.R.L.	ICT and web communication
7	ECONOETICA S.R.L	ICT and Wireless and mobile system
8	BRANCIFORTI ELETTRONICA	Electronic
9	100100 SRL	ICT and communication
10	DEGENE SRL	Pharmaceutical
11	F&M	Microbiology, photosynthesis
12	NETSENSE S.R.L.	ICT and Wireless and mobile system
13	EHEALTHTECH	Healthcare
14	ECOBIOSERVICES AND RESEARCHES	Biotech and Biomedical
15	DR WOLF S.R.L.	ICT and software

In the same area, the University of Florence is planning to build new spaces to host other scientific-technological research centers and it's planning to create a University-Firm laboratory on which it will systematically convey initiatives to bring entrepreneurs closer to students (see for more details Vallini and Simoni, 2006).

The University of Florence has, also, an office for patenting and spin-offs with the goal of facilitating the technological transfer and the commercial use of the results of researches conducted. The four academic spin-offs started (see table IV) use University-owned patents and are participated by the researcher(s), the University and one or more partners.

Table IV: University of Florence spin-offs

1	ESPIKEM	Pharmaceutical, biomedical
2	PROTERA	Molecular science
3	F&M	Microbiology, photosynthesis
4	DEGENE SRL	Pharmaceutical

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4. SOME SPECIFIC LESSONS FROM UNIVERSITY OF FLORENCE CASE

Could higher education programs and entrepreneurial activities offered by University of Florence became strategic factors for generating new entrepreneurship? And, could higher education programs and entrepreneurial activities support collaboration between universities and entrepreneurship and aid future entrepreneurs in the creation of a start-up?

Our analysis clearly revealed how the entrepreneurial activities- including higher education programs- offered by University of Florence can certainly create the conditions for future entrepreneurs:

- to acquire managerial competence and technological knowledge, skills, expertise and abilities and share and exchanges ideas, projects and business plan,
- to be able to exploit important opportunities, and to acquire strategy, management, relational skills that are indispensable for the solution to problems that all entrepreneurs must face in the start up phase,
- to network individuals and institutions such as investors, potential partners, business angels and venture capitalists.

The manner in which such activities are promoted is showing a gradual shift from one way of thinking based on education and training of the sole individual to a new way of thinking concentrated on reaching results by way of groups and teams of students and professors. As result, abilities are put to better use and results achieved and experience matured are exploited more productively, producing changes and new influences that impact on the entire system (MAIR Resource variable). Moreover, interactivity and cooperation can allow individuals to obtain feedback, to take part in extensive collaboration, to share experiences, and to learn from each other, guaranteeing a systematic approach to entrepreneurial training.

In this sense, the ability of entrepreneurial activities to create new entrepreneurship can be measured by the propensity and capability of the programs (figure 4):

- to facilitate a potential entrepreneur to process and evaluate new entrepreneurial ideas,
- to exploit and interpret a possible technological finding or research results,
- to recognize a potential market demand
- to promote stable relationship and fruitful partnership, and consequently
- to develop confidence towards the possible option of becoming entrepreneurs.

The figure 4 shows the relationship and opportunities opened by entrepreneurial activities in the subsequently steps of the start ups process.

Figure 4: MAIR Model, Entrepreneurial activities and start up process

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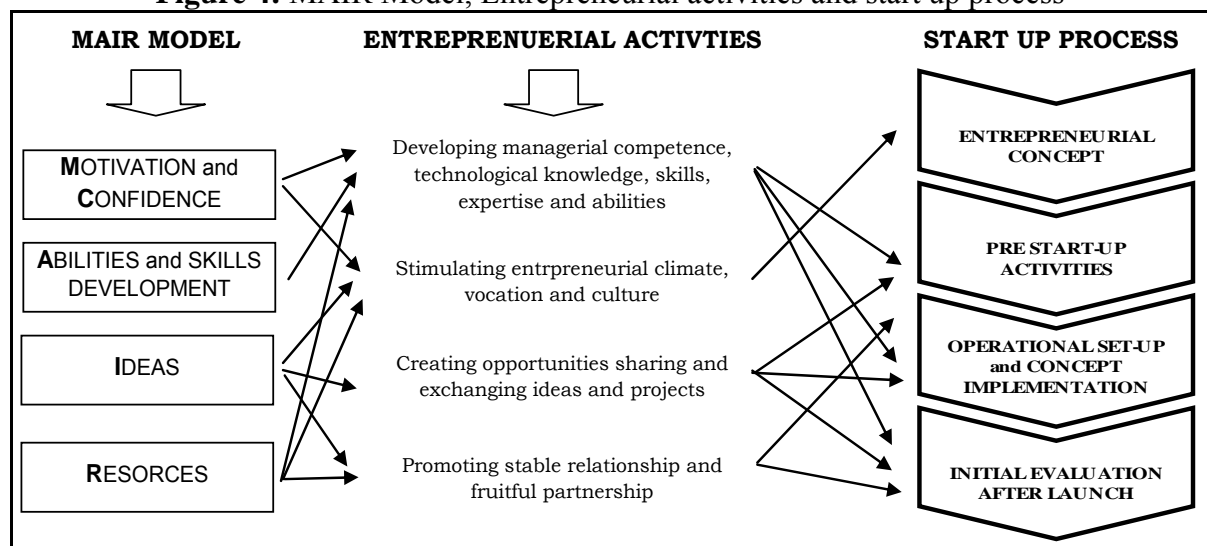
The scheme shows that higher education programs play a crucial role during all steps in a start-up process affecting motivational, behavioral and personal variables (Peterman and Kennedy 2004) of the "will-be" entrepreneur and his success potential, and developing managerial competences and technological knowledge. But, if, on one hand, higher education programs can facilitate the development of entrepreneurial processes, the programs by themselves my be not sufficient. In fact, we believe that the commitment of university institutions to produce beneficial effects on the increase of new entrepreneurship should go beyond the mere education and training of the individual. A constant and consistent commitment should also be made on the creation of networks for local cooperation and development of entrepreneurial services (e.g. in terms of activity for technology transfer or spin off activities). Adopting and following this integrative holistic approach a potential entrepreneur could be able to fully exploit the knowledge powered by universities and take advantage of:

- the acquisition of the competences needed to exploit the research result,
- the policies and tools offered to make entrepreneurial initiatives more appealing thus attracting university researchers to start new businesses,
- the infrastructures, possibly following an incubation model, which on one hand can stimulate both researchers and educators to became entrepreneurs and, on the other hand can facilitate access to specific resources that could favor the success of different ideas on the market.

At present, University of Florence is dedicating resources to the creation and marketing of innovations and research results to be put towards the creation of new entrepreneurship. In fact, it's adopting an holistic approach in the managing entrepreneurial activities (exemplified and discussed here with the MAIR Model) with

- the promotion of activities (including incubation, spin off, technology transfer) carried out in addition to education and training programs to supplement and integrate know-how and competencies,
- a consistent and continual commitment in further studies, research and conference activities to share and exchange new potential business ideas, and
- the creation of an international network which allow potential entrepreneurs to establish contacts with potential financers and with the business and work world.

In conclusion, University of Florence is an example of an institution that is achieving excellence in the promotion of higher education and entrepreneurial programs with results that have great potential to distinguish themselves in terms of entrepreneurial opportunity. However, and in addition to this, it can also be concluded that a greater commitment for the University of Florence should include an increase in the promotion of activities that can allow the community to benefit from technologies developed. In particular we believe, that for the University of Florence it's critical to increase the spin offs activities (the academic spin-offs up to now are only four) aiding the opening of new entrepreneurship which can evolve into successful new businesses and thereby new job opportunities.

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Teaching leadership for improvement
– a case study in distance learning effectiveness

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Abstract

Originality/Value

Our research provides insights to success factors for distance education.

Purpose

We look at the effectiveness of leadership education on distance. Our main purpose is to study if theories and methodologies taught are put into use and to what extent. We also look at the relevance of the topics. Another purpose is to assess effectiveness and success factors of distance education.

Methodology/Approach

Quantitative and qualitative analysis of data from questionnaire responses sent to former students and complemented with some interviews of the same students.

Findings

Our research indicates that leadership knowledge can be transferred effectively from theory to practise by distance education. Starting from the reality of the student is an important success factor. Quick feedback, which is individual, balanced and critical, is also important.

Keywords

Leadership education, distance course

Paper type

Research paper

Introduction

Globalisation brings harder competition and increased challenges of change. For any company to succeed it needs good leadership. In quality management leadership commitment is presented as one of the crucial core principles. In our view leadership is the process of directing the behaviour of others toward the accomplishment of some common objectives. Leadership is influencing people to get things done to a standard and quality above their norm - and doing it willingly. Leading others is not simply a matter of style, or following some how-to guides or recipes. Ineffectiveness of leaders seldom results from a lack of know-how or how-to, nor is it typically due to inadequate managerial skills. Leadership is even not about creating a great vision. It is about creating conditions under which all your followers can perform independently and effectively toward a common objective. Leadership is also a never ending process of self-studies with the purpose to know yourself and your behaviour as

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individual and in a group better. Understanding group dynamics is essential in order to inspire employees into higher levels of teamwork. It could be argued that for any improvement, leadership forms the main resource basis on which success of change relies. It could be argued that all improvement work can be split into two main processes. The first one is creating the interest for change and the second one, improving processes (Isaksson, 2006). In the first process the leadership challenge is to create the willingness for change. In the second process it is to lead the actual change. In order to be a good leader many things are needed. Basic leadership knowledge could be seen to be based on the individual and the individual's behaviour in different group situations. Also, a leader needs to understand how behavioural expectations change in different types of organisational structures.

Gotland University has during several years carried out well frequented distance courses in leadership based on the elements described above. The typical student is a person with a degree working in some organisation, often in a managerial position. Course assessments have indicated appreciation and a high level of student satisfaction. However, the real test comes when theory is put into practise. The questions we have asked are if what is taught also is used and if it is relevant.

Our research is based on two of the basic leadership courses given at Gotland University. The research questions are:

- to what extent Gotland University's current leadership teaching is transferred into practical use in organisations
- how relevant the basic leadership theories are
- what are the success factors
- which are the areas of improvement

Approach

In Figure 1 we have described our research methodology. The core part consists of questionnaires complemented with interviews and some document studies. The methodology is based on triangulation (Denscombe, 2004).
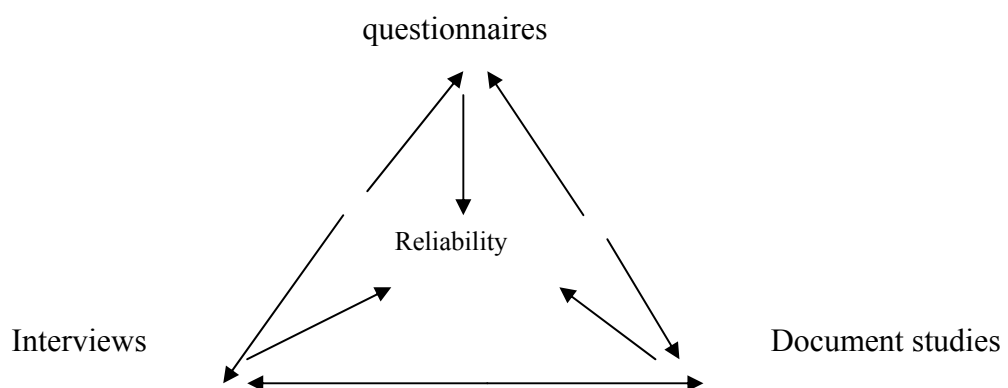
Figure 1: Method triangulation with focus on reliability.

The study is limited to theories used in the courses: "Individual and group based leadership" and "Leadership and Organisation". These courses cover basic organizational theory and group dynamics. Some of the used theories are Schutz' FIRO theory (Schutz, 1994), (Ljungblom, 2008a), Bion's theory about 'work group'/'basic assumption' (Granström, 2007),

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Situation based leadership (Svedberg, 2007; Ljungblom, 2008b), Ås' theories about master suppression techniques (Ljungblom & Norberg, 2007), Bolman & Deal's 4 perspectives to organizations (Bolman & Deal, 2005).

Focus is on the individual and on analysing & exercising leadership in a real life context. More than 90% of the students are mature students, employed and often working full time. The questionnaires have partly been formulated based on the goals in the course plans that define what students should have achieved after the course.

Course plans state that the student should have acquired an increased understanding for:

- his or hers own leadership, based on theories, concepts and models
- the group dynamic process on both individual and group basis
- different types of organisational models
- the role, importance and shape of leadership in different situations and in relation to different organisational models

A research design can be defined as an action plan for getting from an initial set of questions to some answers about the questions (Yin, 2007). Our plan and design looked like this:

- Make a questionnaire
- Find students
- Test the questionnaire on a pilot group
- Modify if needed the questionnaire
- Send the questionnaire
- Compile the answers
- Make interview questions
- Carry out pilot interviews
- Modify if needed the interview questions
- Send interview questions
- Compile the answers from interviews
- Analyse based on data triangulation including literature

And this is the way we did it:

- Make a questionnaire
  - The research question of: *To what extent Gotland University's current leadership teaching is transferred into practical use in organisations* was translated into questions such as: If and how often students think and use the different concepts and theories taught on the courses
  - The research question of *how relevant the basic leadership theories are* was translated into questions on which particular theory has been used and why
  - The research question of *what are the success factors* was translated into questions like what was the best with the course and how it differed from other leadership courses
  - The research question of *what are the areas of improvement* was translated into question like what areas did you miss and why
  - Background information such as gender, type of course etc. was used to find information that could explain different results

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- Test of the proposed questionnaire on a small campus class, which confirmed that questions were OK
- An alumni database for former students (2004 - 2007) was used. First we sent out a demand by e-mail (to 787 people) asking for those interested in participation. We received 100 answers (13%)
- We sent out the questionnaire to the 100 former students who wanted to participate. We received 66 answers translating to a response rate of 66%. This is 8% of the total population
- The answers from the questionnaire were automatically compiled using a data evaluation program called EvaSys. The program presents results in bar charts, with Likert scales and as free text
- The EvaSys free text data was clustered and analysed together with the bar charts and scales
- Interview questions were prepared as a complement to the questionnaire data and to make an in depth analysis for some randomly chosen respondents
- Twelve interviews were carried out
- Answers were compiled and analysed

Some comments to the results from data collection

The first question of interest in participation had a low response rate. We received 100 answers (13%) and 133 (17%) mail demons. Where are the missing 70%? One important reason for the lack of answers is change of e-mail addresses or non use of old ones. This problem has increased during the last year due to the obligatory use of a specific university mail address that is not used after the student has finished the education. This assumption was supported by the fact that out of the 100 respondents 68 were from students from 2004-2006. Our assessment is that there should not be any major bias in the answers we have received.

For those that had expressed their interest we achieved a response rate of 66%. The typical respondent is an employee (50%) and often a leader (27%). The majority are women (73%). The dominating age group is 30-49 years (76%). Many have a university examination (minor 43%, major 33%). One question is why there are so many women in this study? One answer is the fact that a higher percentage of women than men are studying at universities. This applies also for Gotland University. We looked at the statistics from Gotland University 2007 and these show that 61% of all the students were women. We interviewed 6 men and 6 women without any difference in the answers. We cannot explain the high proportion of women on the courses. We have not found any indication of why the course would attract more women than men. Based on discussions on findings we think that results are valid as well for men as women.

Research findings and analysis

Results are structured based on our research questions and an analysis of the findings is presented for each question.

Transfer and use of knowledge

To answer the question "to what extent Gotland University's current leadership teaching is transferred into practical use in organisations" we asked the respondents for how often they think and use the theories taught. The questions were asked for both courses studied and indicated that students think and use the theories taught, see Table I.

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Table I: Thinking and using theories taught based on results from the questionnaire.

Course	Thinking about theories (%)	Using theories (%)
Individual and group based leadership	92.2	75.8
Leadership and Organisation	90.7	84.6

The respondents used a Likert scale to indicate the frequency of thinking of theories and of using them. The frequencies of use were similar on the two courses. In Figures 2 and 3 results from the course "Individual and group based leadership". Only those who had replied yes answered this question.
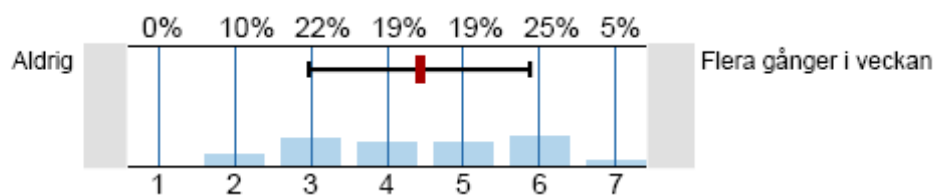
Figure 2: Compiled results for thinking of theories presented on a Likert scale ranging from never to several times per week. For course "Individual and group based leadership".
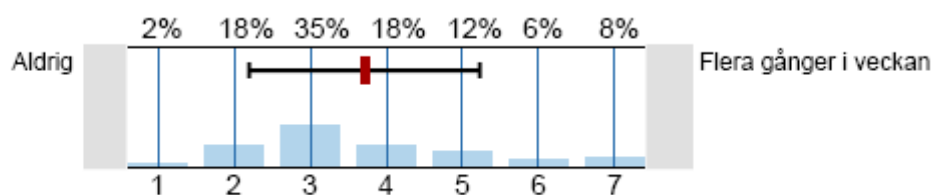
Figure 3: Compiled results for using theories presented on a Likert scale ranging from never to several times per week. For course "Individual and group based leadership".

Results from interviews confirmed the impression that theories were being used. All 12 interviewees thought and used the theories. Several interviewees indicated that the frequency of use depended on the work situation. One interesting comment was that the longer the theories had been in use the more it became a natural behaviour that was used without much thought or reflection.

The findings indicate that the knowledge is being transferred and used by the students.

Relevance of chosen leadership theories

We also wanted to know which theories in particular were thought of and used. Results are clustered from the open question answers after how many times the theories were particularized. Results were similar for both courses and for thinking and using. The results presented in Figure 4 present an average from all the data.

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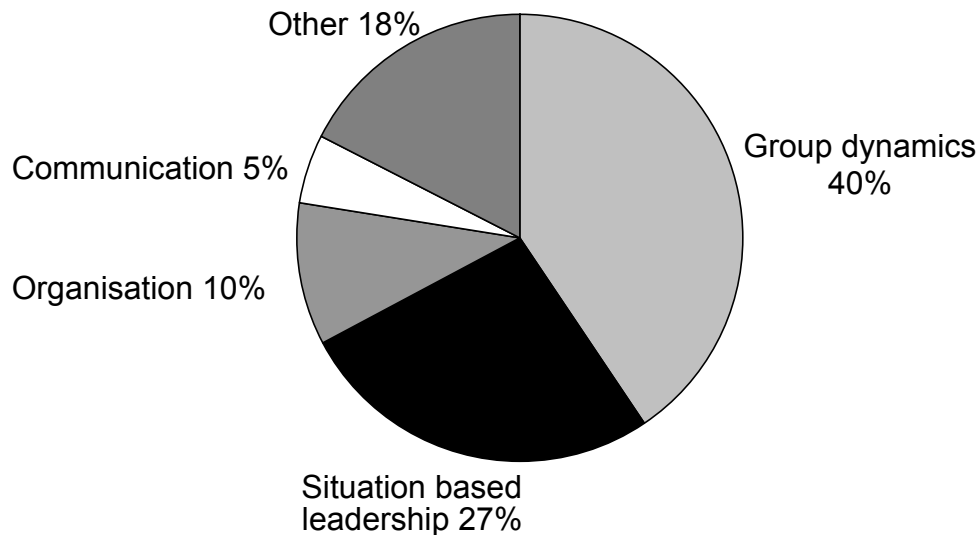
Figure 4: Distribution of theories thought of and used by students.

On the question if something was missing from the course content, 78% answered no. Of the 12 persons interviewed 9 said that they did not miss anything in the course content. Things missing were such as dealing with bosses, communication and coaching.

In the questionnaire we also asked why theories were not used. Out of the 15 answers we received, the majority answered that the reason was not being a leader.

In order to have an idea of how well they could judge leadership education, we asked the interviewees about other leadership courses they had been to. Most (10) had had some kind of other leadership education or training. Often this education was in similar fields like project management and leadership, communication and professional communication.

The relevance of the course content has also been explored by asking questions relating to personal learning. Results from the two courses have been summarised:

- Have you learnt more about yourself? – yes 89.2%
- Have you learnt to co-operate better with others? – yes 68.8%
- Have you become more secure in your working role? – yes 73.4%

We also asked those who replied no to the questions above. For this we have clustered the 15 answers received. These indicate that these students already had the knowledge before the course. This indicates that learning outcomes are as intended.

For each question above we have asked those who replied yes in what way they have learnt more. Results for these questions are presented in Figures 5-7.

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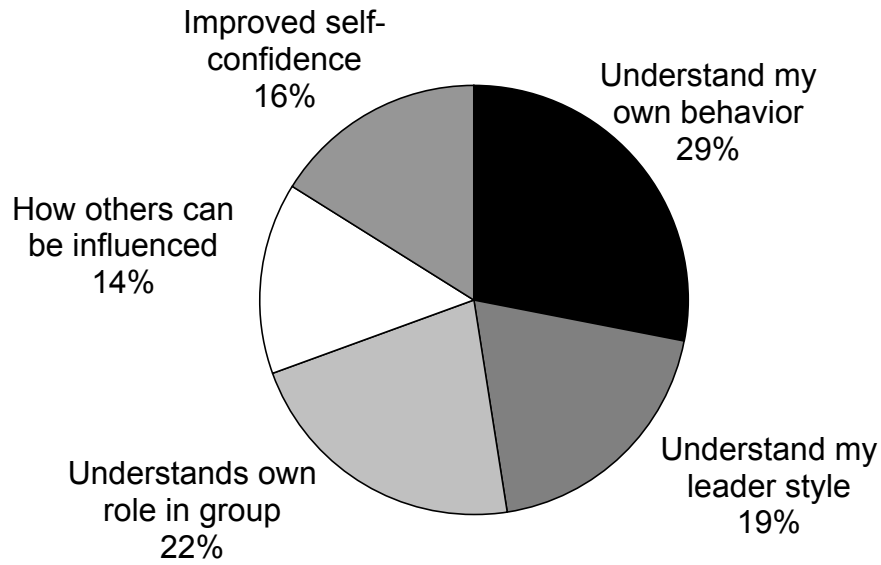
Figure 5: What the students have learnt about themselves.
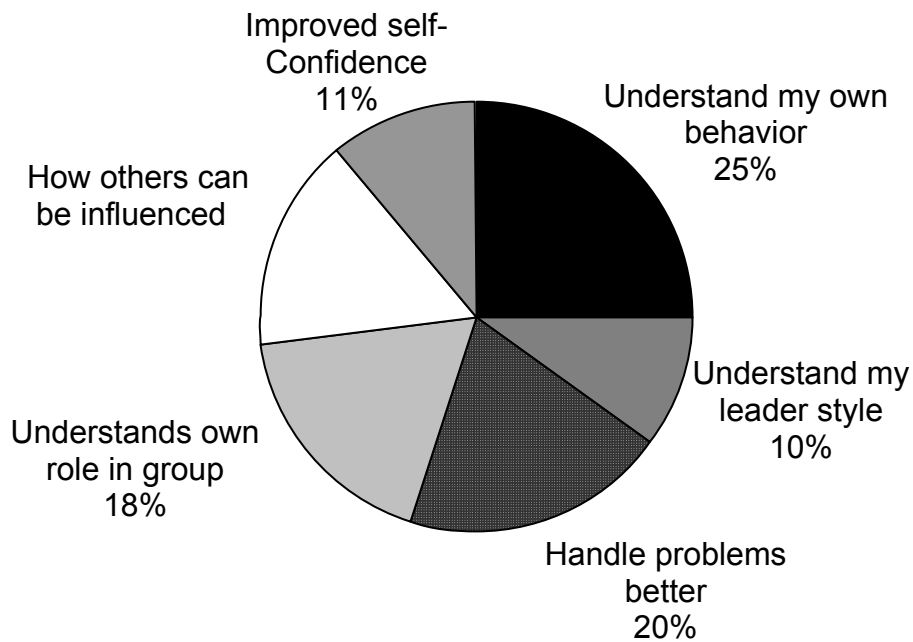
Figure 6: Easier to co-operate

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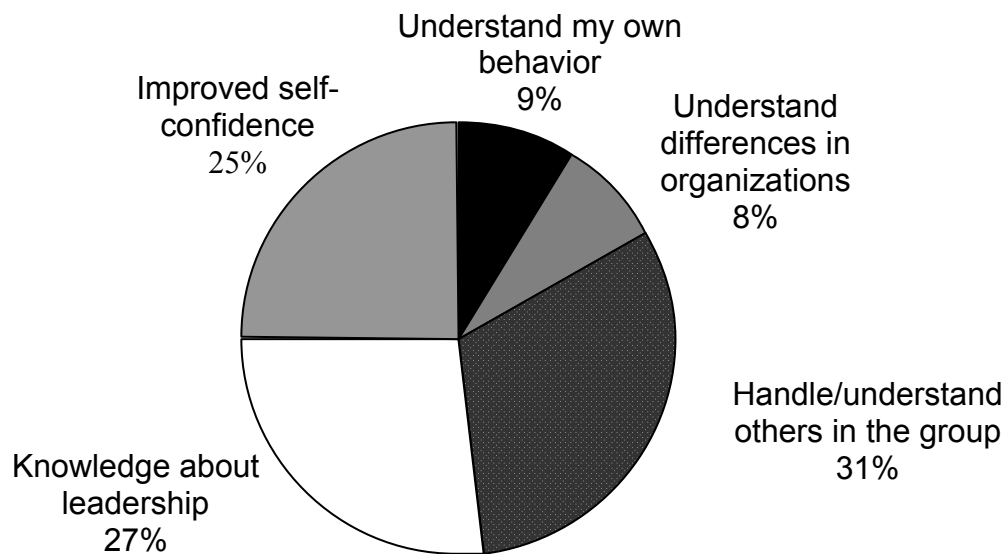
Figure 7: The working role

Leadership on an individual level, as described in Figures 5-7, should be best assessed by the person himself. Based on the results course content seems relevant. We have only received proposals on minor changes and improvements. Still, it hard to assess is if something is missing since respondents might need something that they are not aware of.

Success factors

We have used the free text responses in the questionnaire summary and the answers from interviews to identify success factors. We have clustered the information and carried out a qualitative analysis in which we also have used our experience base.

We believe tat one of the main factors, is that the education proceeds from reality (happenings) and uses theories to explain what happened. This was summarised in one of the interview responses where the respondent said: "Your course is different from others I have been to since instead of trying to force fit theory into practise you use the theory to analyse real life situations". The problems presented to students encourage them to study their own groups, their leaders and their own behaviour in different situations and then to analyse this based on different perspectives. Consistent and overwhelming feedback from students describe that they have learned more about themselves, to handle problems and to lead other people. Pedagogical theory emphasises the importance of starting learning in something which is familiar for the student, which is the case in the courses studied.

Another factor that seems to be very important is the content and speed of feedback given from the teacher to the students. A lot of free text in the questionnaire summary is that feedback is: Given quickly, highly developed, helpful, encouraging, comprised and precise. It also seems to be important and highly appreciated to give both positive and negative

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feedback. Quick feedback means responding to e-mails the same day and giving feedback on reports within two days.

Pedagogy is also commented in a positive way. The students mention good structure, a holistic perspective, flexibility (study in own tempo), change papers with other students and give /get feedback on reflections and specific problems. Students also appreciate the extent of literature, which is varied and gives them multiple perspectives to study their problems with.

Another frequently commented factor is that the theories and models studied are very easy to recognise in real life situations.

One more factor, mentioned frequently is that the teachers in the courses are very "on" – they try to get a campus feeling – to keep contact with students almost daily using mails, organises chats, send pictures and jokes. One student comments this with the words: "I have been getting more attention on this distance course than on many campus courses".

Student feedback is probably affected by the general impression and could even affect feedback on content. There could be a risk of general over-rating. Even if we cannot exclude this risk we think that the effect of on the factual questions on use of theories is negligible.

Based on the results from this study we cannot put any priorities for the different factors identified. We have drawn some conclusions, which have affected the general practises and course design within the department. Information from other distance courses confirms that a quick response is very important. This has been externalised to our 24/7 rule for all courses. Mail reply within 24 hours and report feedback within 7 days. The pedagogical approach of combining theory and practise in an area familiar to the student is applied on many of the quality management department's other courses both on campus and distance with success.

Areas of improvement

This is based on proposals from the questionnaires and from the interviews. Some of the students (22%) asked for physical meetings. In the interviews we asked if they would have participated in a meeting. Only one out of twelve said yes. This person lives in the vicinity of the university. Some of the interviewees made the comment that the reason for their application was that there were no obligatory meetings. One possible improvement is to add non obligatory web-meetings and chat-sessions to satisfy students with contact needs.

In order to improve understanding of the entire area of leadership we have among us teachers discussed making a categorization to highlight the areas we are covering. An issue related to this is the connection between leadership and quality management. Total Quality Management can be seen as a system consisting of values, methodologies and tools, (Hellsten & Klefsjö, 2000). One of the core values is management commitment which could also be expressed as committed leaders. Top management commitment is needed for any change but additionally there probably should be the commitment of all informal leaders. The challenge is to define the methodologies that support the value of leadership commitment. Theories on group dynamics and situation based leadership need to be more clearly defined as part of the organisational methodology resource along with methodologies such as process management, using self assessments and working with 6Sigma, see also (Bergman & Klefsjö, 2003). Current leadership education supports the human resource base in organisations. This could be more clearly integrated with general improvement theory in such a way that increased leadership knowledge also is transferred into improved organisational performance. Quality management traditionally has been relying heavily on quality methodologies and tools.

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However, the quality gurus W.E.Deming and J.Juran have pointed out that only 10-15% of the operational problems can be solved at the operational level with the rest being system and management problems. Methodologies and tools are only of help when management leads in such a way that employees are enabled and encouraged to do the right things willingly. This is definitely a field of further research.

Conclusion and discussion

The proposed answers for our research questions are elaborated and discussed below.

Results clearly indicate that leadership competence is transferred to a high extent on the distance courses studied and that it is being used in the organisations. Non use seems mostly to be related to the position of the former students. Those working as leaders and in groups have better chances of using the theory.

How relevant are the basic leadership theories taught on the two courses? The indication based on student responses indicate clearly that what is taught is relevant. It could be argued that students that do not have an understanding of the entire leadership field would have difficulties in judging what is relevant. Results from interviews indicated a certain understanding of the leadership field. The main argument for relevance is that courses have achieved a high level of personal learning relating to the working place. For judging this perceived improvement the person to judge is the individual. A respondent perceiving an improved self-esteem has achieved something relevant. What about other areas of leadership outside of the personal focus? We have not tried to describe the entire leadership field, which remains for future work. However, we claim that what is taught seems to be relevant in leadership terms for the students.

We have only indicative answers for success factors and this area requires more research. Based on our understanding we think that the important factors are starting from the reality of the student and explaining it with practically relevant leadership theories, giving quick individual feedback that is encouraging but also critical.

The areas of improvement proposed based on results from this research are limited. However, our ambition is to more clearly integrate leadership courses with general improvement theory.

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Identification of Customers' Latent Kansei Needs and Product Design By Rough Set Based Approach

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Abstract

Purpose – This paper proposes a new rough set based kansei engineering methodology, in which rough set model analyzes the interaction effects between principal components presenting customers' need element and between product design category elements, and discusses its effectiveness and limitation through an application example to kansei product development.

Methodology/approach – Rough set model is a promising method to analyze the interaction effects, important information for kansei product design which traditional statistical analysis was difficult to find out. We applied the proposed methodology to kansei product development project of car floor carpet for new car design and compared it with traditional kansei engineering methodology. Based on the proposed methodology, we clarified the patterns of customers' needs to car floor carpet and identified design element pattern rules to realize customers' needs.

Findings – Rough set based approach was very useful in that it is able to clarify customers' latent needs as a combination of principal component elements and relates them to product specification considering its significant interaction effects. Rough set model could clarify customers' latent needs, and then find new design elements interacting the design elements, which were not found out by traditional statistical analysis. At the present research stage, this paper suggests that it is beneficial for product designer/engineer to use rough set model, statistical analysis and his/her expert knowledge.

Research limitation/implication – Rough set based approach to kansei engineering provides more information on customers' needs about product and product design specification. Moreover, it enables a consistent analysis from the identification of customers' needs to design specifications fitted to customers needs. The proposed methodology provides a useful procedure for product designer/engineer to develop "customer-oriented product".

Originality/value – This paper challenges traditional kansei engineering methodology and offers a new rough set based methodology for kansei engineering. It was shown that the proposed methodology was more useful in the practical kansei product design than the existing methodology, especially in the identification of customers' latent needs and the clarification of interaction effects between design

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elements.

1. Introduction

This paper proposes a rough set based methodology for kansei engineering, which identifies customers latent needs represented by the combination of principal components and transforms them to product design elements. The methodology includes the rough set model proposed by the authors (Nishino, 2005a; Nishino, Nagamachi, and Tanaka, 2005b; Nishino, Nagamachi and Tanaka, 2006a). The authors have developed a probabilistic rough set model to analyze kansei evaluation data effectively, and have examined its effectiveness to some product design applications (Nishino, Nagamachi and Sakawa, 2006b; Nishino, Nagamachi, Sakawa, Kato and Tanaka, 2006c). On the basis of the developed rough set model, this paper proposes a rough set approach to kansei engineering methodology. An advantage of the methodology is to provide a method to a systematic approach to the process analysis from the clarification of customers' needs analysis to the identification of design elements or element set. More essential advantage is that it takes account for interactions among elements; interactions among customer elemental needs, interactions among design elements. Human percepts the interactions or "Gestalt" as well as each element of object, and then recognizes or feels it. In kansei engineering (KE) methodology, there were no methods explicitly to model the interactive effects between related elements so far. Rough set based kansei engineering approach is promising in that point because it is good to catch interactions among elements (Nishino and Nagamachi, 2007). By using the proposed rough set based kansei engineering methodology, you will be able to obtain more significant information on kansei product design configuration including the interactive relations between customer elemental needs and between product design attributes.

In this paper, we will propose a rough set based methodology for kansei engineering, and introduce an application example of the methodology to new car floor carpet development project to show its effectiveness. Second section of the paper will describe proposed methodology in which its steps will be described, but the mathematical detail of rough set model will be omitted. Third section will show the results of an application example of the methodology to new car floor carpet development for new car design. In final section, we will conclude the paper and describe future works.

2. Rough set based methodology

2.1 Features and advantages of rough set based methodology

This section describes the main features and advantages of proposed kansei engineering methodology, and then outlines its steps. It was based on the strategic multilevel decision rule extraction model by using rough set model (Nishino and Nagamachi, 2007). The methodology aims to link customers' latent needs, development concepts, and design attributes.

The first important features is that it searches the combination between principal component elements in order to see more deeper customers latent needs using rough set

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model. From customers' latent needs, one can see long–range needs for product development. Traditional kansei engineering approach as well as modern marketing research is not successful to identify long-range customers' needs. The identification of customers' needs is very of importance in kansei engineering methodologies because kansei engineering methodologies should be more directed to customer-oriented development.

The second feature is to discriminate kansei words and decision words. Kansei words are feeling to product such as " beautiful", " higher quality feeling" and so on. On the other hand, decision words are decisive words such as " attractive", "want to buy" and " want to use" which are directly related to customer purchase behavior. We assume that customers discriminate kansei words and cognitive decisive words. In product development from kansei viewpoints, it is essential to see kansei words linked to customer purchase.

The third feature is to identify the combination of design elements as well as each design element contributing to kansei words. Human percepts the interactions or "Gestalt" as well as each element of object, and then recognizes or feels it. It has been much difficult to extract the interactions of design elements contributing to kansei words. Rough set approach adds these features to traditional kansei engineering methodology.

2.2 The steps of methodology

Figure 1 shows a flow of proposed kansei engineering methodology. Left hand side shows the identification steps of customer needs and design elements satisfied with customers' needs. The analytical methods necessary to each step is shown at right hand side.

First step is concept gathering in which we should collect information including developing concepts, image key words and social evaluation words of product.

Step 2 is the deployment of information obtained at step 1 to kansei words. Mainly, product planners or designers perform the step. The key point at this step is faithful deployment from product image and developing sentence. On the other hand, we should select decision words related to direct purchase of customers such as "attractive", "want to buy" and "want to use".

Step 3 is to identify the customers' elemental need to the product by using principal component analysis or factor analysis often used in traditional kansei engineering methodology. From the result, we can know customers' elemental need as a principal component.

Step 4 is to know how customers' latent need as combination of elemental need affects decision words such as "want to buy", "attractive" and so on. We assume that customers' latent needs are represented as combination of elemental needs. The acquired information must be more useful to know a long-range trend of customer wants for product development. At the step, multiple regression analysis /rough set analysis is useful tool. Especially, rough set analysis is useful to know deeper customers' latent needs because it can clarify them as the effect of combination between customers' elemental needs.

Step 5 is to select kansei words satisfied with the customers' latent needs. There are two methods; rough set analysis and expert selection method. The former analyzes the

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relation between the principal component combination and kansei word combination, and then identifies the key kansei words to customers' needs (Nishino and Nagamachi, 2007). The latter is that experts are to select key kansei words referring to the results of principal component analysis.

Step 6 is to identify the design elements and their combination fitted to the selected key kansei words. At this step, one can use quantification theory type I (QTI) /rough set analysis. In the case that there are severe interaction effects between design elements, rough set analysis as well as QT I should be used. Moreover, one can extract different decision rule set by alternating rule evaluation measures; general rule set and specific rule set.

Step 7 is the selection of obtained design rules in view points of useful design rules by experts, and the product design based on the decision rules and expert knowledge. Domain experts had better select "good rules" among the extracted ones by rough set analysis because mathematically extracted decision rules are often technically impossible or uninteresting for design experts.

Kansei engineering step for product development | Analytical method

Kansei engineering step for product development	Analytical method
1. Concept gathering: development concepts, image key words practical concepts, and so on	Information gathering by design experts
2. Kansei and decision words selection	Kansei deployment by design experts
3. Identification of kansei evaluation structure	Principal component analysis
4. Identification of latent kansei needs to decision words	Probabilistic rough set model /Multiple regression analysis
5. Selection of key kansei words satisfied with kansei needs	Probabilistic rough set model / Selection by experts
6. Identification of design elements and their combination fitted to key kansei words	Probabilistic rough set model /Quantification theory type I
7. Selection of design rule and product designing by experts	Design rule/ Expert knowledge

3. Application example to kansei design of car floor carpet
3.1 Experimental conditions

Samples are 25 samples of car floor carpet collected from different Japanese automobile company as shown in Figure 1. Kansei words were 21 kansei words extracted from image key words, new developing car concept and the present car concept of company and practical evaluation concepts such as " good sense", "good shape", "fashionable", "sporty", "clean" and so on. Four decision words were selected as decision words directly related to customer purchase such "attractive", "want to use", "like" and "want to buy".

Subjects are 43 male and 8 female employees, aged 20s to 60s. Each subject evaluated

Figure 2.   Experimental samples

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all the samples while they see and touch them. Each word was measured by 5-point semantic differential (SD) scale.

3.2 Principal component analysis

We computed principal components from the evaluation data of 21 kansei words except decision words. Three significant components were obtained as shown in Figure 2. We can interpret a principal component as a customers' elemental need and customers' latent needs are combinations of elemental needs. Regrettably, because the first component "Factor X- Not factor X " was a key concept in the designing new carpet for new car development and it is secret, we cannot show its concrete concepts here. "High quality-Not high quality" component includes "higher quality feeling", "good shape", "good sense" and so on. "Clean – Unclean" component includes "clean" and so on.

Table I. Principal component

Principal component	Eigen value	Contribution(%)	Accumulated contribution(%)
Factor X - Not factor X	1.60	65.86	65.86
High quality -Not high quality	0.48	19.73	85.59
Clean - Unclean	0.18	7.39	92.99

3.3 Combinations of elemental kansei needs

Table II shows extracted main decision rules for each decision word in order of coverage measure. Certainty indicates the degree for a rule to predict decision word. Coverage indicates the range of customers covered by the rule. Effect measure indicates the realistic effect of a rule normalized by the occurrence frequency of plus or minus score in samples. In decision rule column, A1 is Factor X, A2 is Not factor X, B1 is High quality, B2 is Not high quality, C1 is Clean, and C2 is Unclean, For example, there are two significant rules for decision word "Like"; B1A1 (High quality and Factor X), C2A1 (Unclean and Factor X). The rule B1A1 has higher certainty and coverage than C2A1. We assume that the combination of principal components represents customer' latent kansei needs. No single element rule was not obtained. This suggests that customers' latent needs have some clusters and make the combination of some principal components. The rule A1 B1C1 for the decision word "fit to new car" may be good for product development because of its higher measures. However, the rule may be selected from strategic viewpoints of product development.

To compare with rough set results, Figure 3 shows the ratio of standard regression coefficient of each component for "want to use" and " fit to new car". For example, it should be noticed that the ratio of "fit to new car" is similar to rough set result. For "want to use", while regression analysis suggests higher quality (B1), rough set suggests the combination of not higher quality (B2) and factor X (A1) or clean (C1). However, regression analysis has no rational reasons to construct the combination of principal components because it is statistical linear model of principal components. On the other hand, rough set model explicitly deals with the combination of principal components.

3.4 Selection of key kansei words satisfied with customers' latent needs

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In the case, product design experts selected some kansei words from principal components related to customers' needs, such as "word X", "higher quality feeling" and so on. Regrettably, we cannot show kansei "word X" here, because the word is very

Table II. Combination of components rough set

Decision word	Decision rule	Support	Certainty	Effects	Coverage
Like	B1A1	105	0.294	1.609	0.451
	C2A1	51	0.250	1.368	0.219
Want to use	A1B2	58	0.227	1.142	0.228
	C1B2	34	0.222	1.115	0.134
	A1C2	51	0.250	1.255	0.201
Attractive	C2A1	55	0.270	1.469	0.235
Want to buy	A1B2	53	0.208	1.238	0.248
	C1B2	30	0.196	1.168	0.140
	A1C2	48	0.235	1.402	0.224
Fit to new car	A1B1C1	93	0.365	1.735	0.347
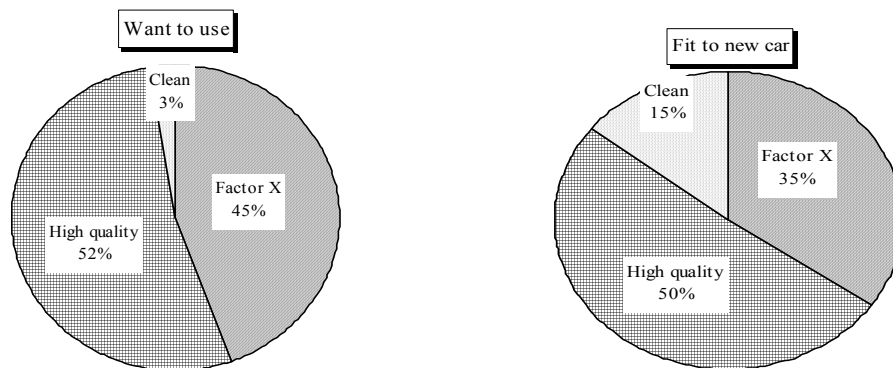
Figure 3. Ratio of standard regression coefficient

important one for newly developing product and it is secret.

3.5 Identification of design elements fitted to key kansei words

3.5.1 Analysis by quantification theory type I (QT I)

Table III shows the results of "higher quality feeling" by QT I. Total number of items and categories were 33 and 199 respectively. Some items were grouped as an analysis unit according to technologically related items. For example, a basic design unit includes "basic color", "brightness", "surface color", "material" and so on as shown in the top of Table III. A pile design unit includes "pile type", "pile color pattern", "pile pattern" and "basic pattern" as shown in the bottom of Table III.

We constructed six units considering interactions among items. We have executed QT I using a unit. We obtained good regression equations for predicting kansei words as indicated by a multiple regression coefficient.

You can see that the design elements for "higher quality feeling" in the basic design analysis unit are "middle brightness in color" or "1350-2000 in length" by checking partial regression coefficients and category scores. In pile analysis unit, the design elements for " higher quality feeling" are "cut in pile type" and "diagonal in pile pattern".

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In this way, one can obtain important information on design elements for designing kansei product by QT I. Moreover, we also obtained good information for the other key kansei word.

Table III.　"Higher quality feeling" by QT I

Item	Category		Category score	Correlation	Partial correlation	Multiple correlation
Basic color	1	black	0.069	-0.025	0.508	
	2	brown	-0.177			
Brightness	1	high	0.231	0.396	0.777	
	2	middle	0.350			
	3	low	-0.299			
Surface color	1	one	0.048	0.084	0.375	
	2	two	0.012			
	3	three	0.068			
	4	over four	-0.221			
Material	1	nylon	0.008	0.105	0.014	
	2	PP	-0.001			
Surface hair	1	intermingle	0.121	0.347	0.747	0.869
	2	middle strong twist	0.136			
	3	strong twist	-0.363			
	4	others	0.056			
Length	1	1350～2000	0.238	0.352	0.679	
	2	2001～2500	0.006			
	3	2501～3000	-0.036			
	4	over 3001	-0.320			
Touch	1	hard	0.009	-0.054	0.494	
	2	a little hard	-0.235			
	3	a little soft	-0.153			
	4	soft	0.071			
Pile type	1	cut	0.254	0.264	0.747	
	2	loop	-0.370			
	3	high loop	-0.257			
	4	cut and loop	0.063			
Color pattern	1	dot	-0.021	0.452	0.529	
	2	square	-0.093			
	3	width	0.237			
	4	length	-0.221			0.891
	5	diagonal	-0.038			
	6	none	0.022			
Pile pattern	1	dot	0.010	0.587	0.747	
	2	square	0.090			
	3	length	-0.601			
	4	diagonal	0.248			
	5	none	-0.199			
Basic pattern	1	length	0.216	0.191	0.753	
	2	width	-0.205			
	3	none	-0.156			

3.5.2 Analysis by rough set (RS) model

Table IV shows 12 sorted decision rules and its evaluation measures in order of higher coverage among more than 200 extracted ones by RS model. We extracted the decision rules with higher values than the thresholds of both certainty and coverage

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measures. Threshold of certainty is the average probability 0.276 of "higher quality feeling" to all the samples. That of coverage is 0.18.

For example, the rule R3 indicates that if using the rule to configure new car floor carpet, it will give customers "higher quality feeling" with certainty 0.361. Coverage indicates the range of customers covered by the rule. In this rule, it is 21.1%. Thus, the rule R1 has the widest covering of customers, 23.1%, but its certainty is rather lower, 0.396. The rule with highest coverage is R1 which indicates that "diagonal in pile" element is important for "higher quality feeling" to product. Effect measure indicates the realistic effect of a rule normalized by the occurrence frequency of design element in samples. In the case, R6 has highest effect upon " higher quality feeling", 1.558.

Table IV. Decision rule for "higher quality feeling" and its evaluation measures

Design rule	Certainty	Effect	Coverage
R 1	0.396	1.433	0.231
R 2	0.395	1.429	0.228
R 3	0.361	1.308	0.211
R 4	0.361	1.308	0.211
R 5	0.361	1.308	0.211
R 6	0.430	1.558	0.188
R 7	0.424	1.534	0.185
R 8	0.424	1.534	0.185
R 9	0.417	1.510	0.182
R 10	0.417	1.510	0.182
R 11	0.417	1.510	0.182
R 12	0.417	1.510	0.182

Table V. Comparison of RS model and QT I

Design rule	Condition part				Quantification			
					D1	D2	D3	D4
R1	pile(diagonal)				**			
R2	pattern distance(60-90)	lockstech color(same	pile length(wide)				*	
R3	basic color(brown)	color pattern (none)						
R4	basic color(brown)	pile color pattern (none)						
R5	brightness(high)	color pattern (none)						
R6	pattern distance(lengh)	max P length(10.0-13	pile length(wide)			**	*	
R7	heel pad(none)	overlock width(10)	pile pattern(low loop)	hidden loop(yes)	*		*	**
R8	heel pad color(none)	overlock width(10)	pile pattern(low loop)	hidden loop(yes)			*	**
R9	heel pad(none)	colors(two)	pile length(wide)		*		*	
R10	heel pad(none)	colors(two)	hidden loop(yes)		*	**		
R11	heel pad color(none)	colors(two)	pile length(wide)				*	
R12	heel pad color(none)	colors(two)	hidden loop(yes)				*	

Table V shows the content of each decision rule and the comparison between decision rules and QT I. Symbol "D1" to "D4" corresponds to a condition of a decision rule, respectively. Symbol "**" indicates strongly significant design elements suggested by QT I. For example, the decision rule R7 indicates that if a floor carpet includes "no heel pad", "10 in overlock width", "low loop in pile pattern" and "hidden loop", then the floor carpet will give customers "higher quality feeling" with the certainty 0.424 and coverage 18.5%. Four conditions are "D1" to "D4". In that case, "D1" indicates the first condition of rule "no heel pad". Symbol "*" indicates that QT I also suggest "D1" is

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weekly significant for "higher quality feeling". We may compute decision rules for a combination of some kansei words, for example, " higher quality feeling and clean".

3.5.3 Rule filtering by experts

Product design experts filtered these rules in viewpoints of good design rule, and selected useful ones for new floor carpet design among more than 200 rules. Design experts selected R7 and R8 for designing higher quality product. The selected rules were more complicated and long condition rules. You should notice that these decision rules are nearly consistent with the results of QT1, but the decision rules by RS model include design elements not suggested by QT I. For example, the item of "overlock width" is not found out by QT and is included in R7 and R8. However, design experts pointed out that it is the item interacting with "pile pattern" and "hidden loop" found out by QT I. Moreover, through searching all the decision rules pointed out by product experts, we found that design experts tended to select many decision rules with lower coverage. For example, the experts selected the rules with condition " more than 3 kinds in pile length" and "weak contrast in lockstitch color". Its coverage was rather lower, 0.029. This suggests that design experts may like more specific design rules for product design.

4. Conclusion

We proposed a rough set based kansei engineering methodology. We have applied proposed methodology to a new car floor carpet development project for new car design, and we got much more interesting design rules. We pointed out that on the present research stage, it will give better solution to use both traditional methodology and rough set based methodology. Moreover, we found out that it is significant for product design experts to filter design rules. In near future work, further, we will refine our methodology by applying it to more product development.

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Developments of Home Electric Appliances with Kansei Ergonomics – SANYO cases: Kansei and Kinematic considerations on Washer-Dryer and Electric Shaver

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Abstract

Purpose – Development of "Washer-Dryer" and "New shaped electric shaver" with Kansei ergonomics.

Methodology/Approach – Recently, the "Washer Dryer" type washing machines with horizontal or slant drums are becoming popular in Japan. We measured and analyzed posture while using the washing machines with 3 dimensional motion capture measurement devices. Subjective Kansei and usability questionnaires were also used. After the measurement, measured working postures were analyzed with the human kinematic model (3D SSPP) that can estimate theoretical value of the muscle tension and loads on the lumber vertebrae, knees and ankles. Three types of washers (European type; box shape and horizontal drum, Conventional Japanese type; a vertical drum, New type; slant drum with higher profile) were used for the experiment. 12 female participants aged between 22 and 43 took evaluation.

On electrics shaver, electromyogram of lower arm and pressure to the face was measured.

Findings – On Washer-dryer, theoretical muscular forces (%MVC; percent of maximum voluntary contraction which is a percentage of the maximum muscular force of 50 percentile female) on elbow, hip, knee and ankle were estimated. Sum of the %MVC of the new type was 116, European type was 133 (knee tension is high) and conventional Japanese type was 284 (ankle tension is 110, which exceeds the limit). The new type requires only 40% of the muscular force required for the conventional Japanese type. From the subjective evaluation, the new type was better

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than the European type washer and conventional type on subjective fatigue evaluation and general evaluation, with statistical significance with one-way ANOVA.

On shaver, EMG was reduced 20% from conventional shape and it was and statistically significant. Pressure force to the face skin was reduced 85% and also significant.

Originality/Value of paper – The practical case examples of improvement with Kansei ergonomics, through the commercial product development

Keywords *Kansei ergonomics, product development, washer-dryer machine, electric shaver*

Paper type *Research paper*

1. INTRODUCTION

Kansei Ergonomics: In the beginning era of Kansei engineering from 1970s to mid 1990s, research results were published and presented mainly in several societies of Ergonomics. In Ergonomics, ensuring safety and removing unpleasant things are immediate task. Physical traits such as torque, acceleration and vibration, physiological measurements like electromyography are main measurement techniques. Prof. Nagamachi originated Kansei engineering, by combining psychological Kansei measurement and analysis methodologies to ergonomics. We have been applied Kansei engineering to many product development projects from 1980s.

In 2000s, we have been involving to many more product developments and we have recognize again that Kansei engineering and Ergonomics are indivisible. Attractive product can not made only from ergonomics, and Kansei engineering needs eloquent evidences those shown in figures. Thus, Prof. Nagamachi and us are proclaiming the needs of Kansei Ergonomics. In this paper, we show two examples of Kansei-Ergonomics based product developments.

Washer and Washer-Dryer machine:

Recently, "Washer-Dryer" type of washing machines with horizontal or slant drum is becoming popular in Japan. Traditionally, Japanese washing machines have had vertical drums and these types are still popular. Users of vertical drum washer have to bend their back and stretch their arm to put in and take out laundry. Meanwhile in Europe, horizontal drum type washing machines have always been popular. This type requires the crouching posture for putting in and taking out laundry because of its lower height.

The "washer-dryer" has rather different mechanisms to the vertical drum washing machines, and therefore require a completely new mechanical design. These new washer-dryers have horizontal or slanted rotational axis of the drum. Thus, the shape of the washing machine was greatly changed; to make loading operations easier, the door position was modified.

In this research, physical loads and usability between the washer-dryer, the traditional drum type and European type washing machines were compared. This comparison was performed using subjective evaluations, 3D motion capture and estimation of body part loads using a human kinetics computer model.

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New Shaped Electric Shaver: Home electric appliances are changing from low-price & mass production to decent price & high-function. Mechanism of electric shaver has inner blade, which reciprocatory moves inside of the mesh outer blade. Thus, adding more pressing to face, shaving becomes the more blunt with adding load to inner blade. Although conventional stick shape shaver tends user to add pressure to his face. SANYO engineer thought bending shaver head and grasping it with pen-grip like T-shape razor will solve the problem. We have verified the idea with experiments and measurements.

2. METHOD OF THE WASHER EVALUATION EXPERIMENT

In the experiment, we requested the participants to take out laundry from the machine. As a laundry model, two towels were placed at the bottom of the drum, and two blankets (each 1.6 kg) were placed on the towels. These items were dry.

The participants were asked to open the door, take out the laundry piece by piece, put them into a basket that was placed on the floor, and then close the door.

The participants were 12 females aged 20s to 40s. Four subjects were smaller height (148 to 153cm), 5 subjects were around 158cm (Japanese female average) and 3 taller subjects were around 165cm.

Three laundry machines were used: a European floor-type box-shaped washing machine (SANYO AWD-500; referred to below as "EU type"), a typical vertical-drum washing machine (SANYO ASW-800; referred to as "vertical drum"), and a slanted-drum fully-automatic washer-dryer machine (SANYO AQ-1; referred to as "slanted drum"). Height to the center of the opening was 47.5 cm for the EU-type machine, 90 cm for the vertical-drum machine, and 81 cm for the slanted-drum machine. Note that the opening of the vertical-drum machine faces straight up, which means that laundry will have to be lifted higher than the actual height of the door.

Fig.1. Washers and a New Washer-Dryer; European (EU) type AWD-500, Vertical Drum type ASW-800 and Slanted Drum type washer-dryer AQ-1(Left to Right).

3. RESULTS OF WASHER SUBJECTIVE EVALUATION

Subjective evaluation was carried out by asking the participants a set of questions each time the required task was completed. Of these questions, 5 were related to fatigue, 5 on usability and a final question on the general usability of the washing machine. Table 1 lists the questions asked. Each question was answered on a 5-level basis.

Table 1 Questions for Subjective Evaluation

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1. How tired does your entire body feel?
2. How tired are your neck or shoulders?
3. How tired are your upper arms?
4. How tired are your back?
5. How tired are your knees?
6. How easy was it to pushing the door open button?
7. How easy was the machine to opening and closing the door?
8. How easy was the machine to checking inside the drum?
9. How easy was the machine to inserting a hand or arm inside the drum?
10. How easy was the machine to taking out laundry?
11. How easy was the machine to use?

We used one-way analysis of variance to investigate whether differences in the evaluations from one machine to another were significant. We found that differences between machine types for the question "How tired does your entire body feel?" were indeed significant ($F_{(2,33)}=11.68$, $p=0.0001$) and that the evaluations rated the slanted-drum machine as best followed by the vertical-drum machine and the EU-type machine.

For post-hoc pair-wise comparison, we used Tukey-Kramer Honestly Significantly Different (HSD) test, it was found that the slanted-drum machine and vertical-drum machine were evaluated significantly better than the EU-type machine ($p<0.05$).

There are significant differences between washing machines on following questions; "How tired are your neck or shoulders?" ($F_{(2,33)}=9.85$, $p=0.0004$), "How easy was the machine to use?" ($F_{(2,33)}=22.30$, $p<0.0001$), "How easy was it to opening and closing the door?" ($F_{(2,33)}=7.98$, $p=0.0015$), and "How easy was the machine to checking inside the drum?" ($F_{(2,33)}=9.48$, $p=0.0006$). Similarly, a HSD test revealed that the slanted-drum machine and vertical-drum machine were evaluated significantly better than the EU-type machine ($p<0.05$).

There were also differences between the machines for "How easy was the machine to taking out laundry?" ($F_{(2,33)}=7.98$, $p=0.0015$). For this question, the machines were highly evaluated in order of slanted drum, EU type, and vertical drum, and a HSD test revealed a significant difference between the slanted-drum and vertical-drum machines ($p<0.05$).

The question "How easy was the machine to pushing the door open button?" applied only to the slanted-drum and EU-type machines that have door buttons, and it was found that the former was evaluated significantly higher than the latter ($F_{(1,19)}=14.31$, $p=0.001$).

The above results indicate that the slanted-drum machine was evaluated higher for all questions and that the EU-type machine was inferior in a statistically significant manner in terms of fatigue and ease of use. It was also found that the vertical-drum machine, which has been widely used in Japan until recently, was not very good for taking laundry out from the drum. We will investigate the relationship between these results and working posture as determined by motion capture described next.

4. MEASUREMENT OF WORKING POSTURES WITH WASHERS BY MOTION CAPTURE AND ANALYSIS OF JOINT ANGLE

We have measured working postures with 3D motion capture system. The system was Proreflex system (Qualisys Inc., Sweden) which has 5 IR cameras. Using a 3D

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motion-capture system employing infrared cameras, we measured working posture in terms of coordinate values for various parts of the body. Sampling rate was set at 120 samples/s and spatial resolution setting during measurements was 5 – 10 mm. Figure 2 shows the posture of a subject with a height of 158 cm (the average for Japanese women) during maximum bending of the body when removing a towel from the drum.

Markers were set at 15 locations on the subject's body: head, left and right shoulders, left and right elbows, back (dorsal) of each hand, left and right greater trochanter, left and right knees, left and right ankles, and left and right toes (on the subject's slippers).

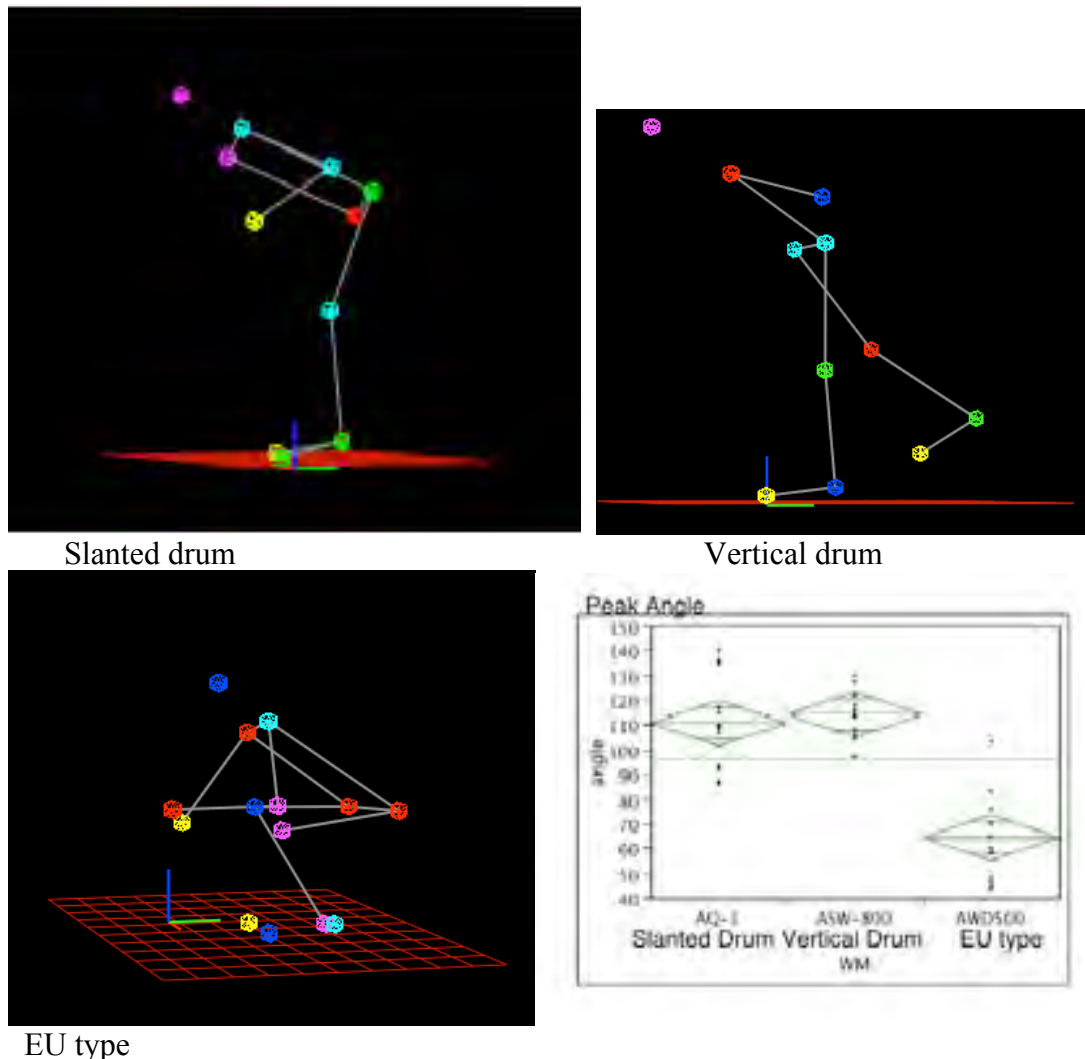Slanted drum   Vertical drum

EU type

Figure 2: Posture during maximum bending of body (158cm young female)
and graph of Angles formed by the knee, greater-trochanter and
shoulder for different machines

Using data from motion capture, we measured and analyzed the angle formed by the knee, greater-trochanter and shoulder. This angle was 100 degrees (averaged between subjects) for the slanted drum, 114 degrees for the vertical drum, and 64 degrees for the EU type (Fig. 2). Since standing posture is near to 180 degree, the larger angle is better.

One-way analysis of variance indicated that differences between machines were significant ($F(2,33)=37.622$, $p<0.0001$). Results of a HSD test revealed a significant difference between the slanted-drum and EU-type machines and between the vertical-drum and EU-type machines ($p<0.05$).

The angle formed for the slanted drum was $110/64=1.71$ times larger than that of the EU type, which can be interpreted as a 70% improvement. For the EU type, the capture screen showed that laundry could not be put in or taken out without squatting completely. This is the reason for the poor evaluations given to the EU-type washing machine for the questions "How tired does your entire body feel?", "How tired are your knees?", and "How easy was the machine to use?" The vertical drum gave a posture closer to the vertical stance than that of the slanted drum, but since the vertical drum is deep, almost all of the participants reach the towel at the bottom of the drum without raising one foot off the ground and stretching inside the drum. This is why the vertical drum was poorly evaluated with respect to "How easy was the machine to taking out laundry?" The relationship between the subjective evaluation and working posture has therefore been clarified by measuring body posture through motion capture and calculating the angle of body bending in the above way.

It has been shown that the vertical drum requires an off-balanced posture. The entire body load at this time cannot be estimate solely on the basis of coordinate and angle data obtained through motion capture. The load on the lumber vertebra that cannot be directly measured is also a decisive factor. Accordingly, giving due consideration to the mass of various parts of the body, we attempted to estimate such loads using a kinematic model.

5. ESTIMATION OF STATIC LOAD USING A KINEMATIC MODEL

We have estimated the load on various parts of the body using a kinematic model. To perform our calculations, we used the 3D Static Strength Prediction Program (3D SSPP) developed by a research team lead by Professor Don Chaffin at the University of Michigan. Professor Chaffin has been researching kinematic models of the human body and applying them to posture analysis of assembly of production lines for about 30 years.

As shown in Fig. 3, the Chaffin model features a human body with a basic structure consisting of 7 links. Links are; forearm, upper arm, torso (shoulder to lumbar vertebra), sacral vertebra to pelvis, femoral head to knee, shank and foot.

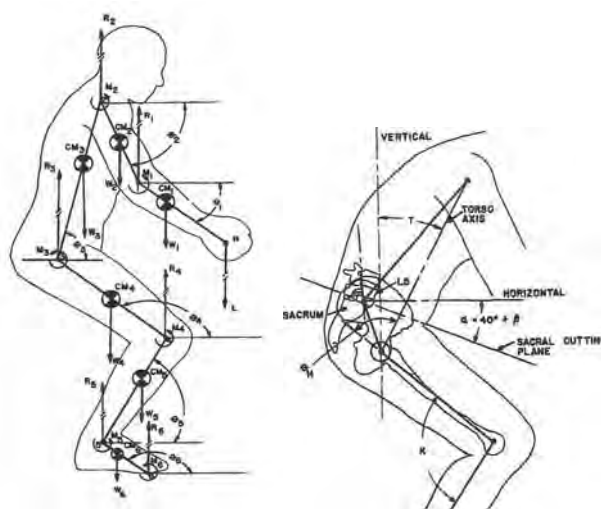Figure 3: Body links (entire body) and hip section [1]

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The model takes the following values as main parameters; load, own weight, height and joint coordinates. Center of gravity is determined by each part's size and weight. For the example, a load of 5 kg (49N) is held in the hand with the combined weight of the forearm and hand is 15.8N (Fig.3).

The upper arm from the elbow up holds up this load with force R_{elbow} in a stationary position. This can be expressed as $-49N-15.8N+R_{elbow}=0$, which means that R_{elbow} can be calculated to be 64.8N in the upward direction.

Rotation moment M_E is in equilibrium with the (center of gravity of the upper arm X the weight of the upper arm and hand) + (length from the joint to the grip X the load). This can be expressed as $17.2cm(-15.8N) + 35.5cm(-49N) + M_E=0$.

This gives $M_E=2011.3Ncm$ (20.113Nm). This assumes the forearm to be in a horizontal position, so any deviation from the horizontal in the form of $-\tilde{}_E$ will give a result of $\cos \theta _E(M_E)$.

For the upper arm, the upward pulling force at the shoulder can be expressed as $RS=W_{UA}+R_{elbow}$, where W_{UA} is the upper arm's own weight. The torque at the shoulder can be expressed as $MS = -(SCM_{UA})(W_{UA}) -(S_E)(R_{elbow}) -(M_E)$, where SCM_{UA} is the distance from the shoulder to the center of gravity of the upper arm, and SE is the length of the upper arm.

Lowering the upper arm from the horizontal gives a result of $\cos \theta \ \tilde{}M \ _S\tilde{}$. In the above way, load and joint moments can be progressively calculated for various parts of the body (Fig. 4).
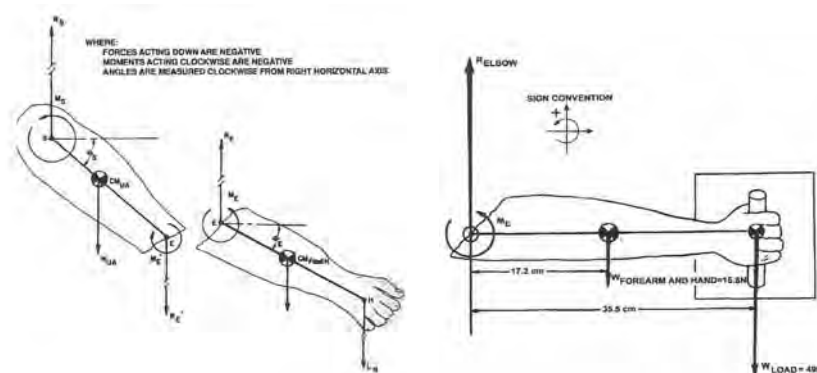

Figure 4: Left :Forearm and load, Right: Upper arm and forearm (from Ref. [1])

Table 2: Values estimated by model (158cm young female)

Subject: 158cm/53 kg	L4/L5 Comp	%MVC(50%ile) elbow	hip	Knee	Ankle	Sum (%MVC)	Sum(%MVC) / 400
Slanted drum	1732	12	54	25	25	116	0.29
EU type	1801	17	31	59	26	133	0.3325
Vertical drum	1431	8	75	91	110	284	0.71

Using this model, we estimated the pressure (N) on the disk between the fourth and fifth lumbar vertebra and the maximal voluntary contraction (%MVC) for the muscles involved in the elbow, hip, knee, and ankle joints for the posture corresponding to maximum bending of the body (for a 158-cm, 53-kg participants). Participants' height

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and weight were used for estimation. Referring to Table 2 and Fig. 5, the slanted drum exhibited smaller muscle strengths except for the hips. For the vertical drum, the pressure on the inter vertebrae disk was smaller than that of the other two machines since the back was not bent very much. On the other hand, laundry cannot be removed from the bottom of a vertical drum without raising one foot so that the load on the ankle of the other foot exceeded 100%. The load on the hip and knee was likewise high.

Figure 5: Calculation screen for vertical drum (158cm young female)

6. RESULT OF LOAD ESTIMATION OF WASHERS

Summing up individual %MVCs and comparing overall %MVC between the different machines revealed that the slanted drum was smallest with a muscle load about 60% smaller than that of the vertical drum. On comparing the slanted drum and the EU type, it was found that the latter exhibited a smaller load on the hip but 2.36 times the load on the knee due to the fact that a squatting posture must be taken. The above results demonstrate that the slanted drum provides improved posture.

7. MEASUREMENT OF SHAVER EXPERIMENT

We have used two types of shavers; conventional stick type and new prototype of pen-grip shaver. These two shavers have same grip part, thus their grip length and diameter are identical. Stick type has its head at 15 degree from the grip and pen grip prototype has at 80 degree. The latter can use with pen grip by larger bending of its head.

Electromyogram (EMG) measurement:

Factor of the experiment is difference of EMG between NS1 (existing Stick type) and Pen grip prototype (based on NS1).

Electrodes are attached on flexor digitorum superficialis and on flexor digitorum profundus with bipolar derivation. Measurement was done with 2 channels and the earth was taken on elbow joint bone. Measurement device was Biopac MP30 (Biopac Inc.) and its sampling rate was 500 Hz.

Pressure to face measurement: Piezo pressure sensor was attached behind the blade of the shaver.

Factor of the experiment is difference of pressure to the face between stick type and pen grip prototype. Measurement was also done with Biopac MP30.

Instruction to the participants: An instruction paper which has applying to the face and shaving direction was given to the participant. Task is moving shaver 3 times

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at the 7 different sites; midst of the under the chin, right and left of it, on the chin, under the nose, right cheek, left cheek. Subjects are 7 men in their 20s.

Result of EMG measurement: As shown in Figure 6, Pen grip prototype has smaller voltage. EMG integral values (mV×Sec/500(Hz)) of 2 shavers (sum of 7 sites) were compared with measurements of 7 participants. The ratio between pen grip prototype and stick (averaged between subjects) are; 0.60 at flexor digitorum superficialis, 0.95 at flexor digitorum profundus, 0.78 at combining both muscles. Thus, 22% EMG reduction was shown on pen grip prototype.

Statistical distribution of differences between pen-grip and stick was not along standard distribution, by investigating with Shapiro-Wilk W test. This is the paired data since the same subject used both shavers. Thus, we had tested with Wilcoxon signed-rank test, which performs non-parametric test of paired data. As the result of the test, difference of EMG integral value between two shavers is statistically significant ($p<0.0001$).
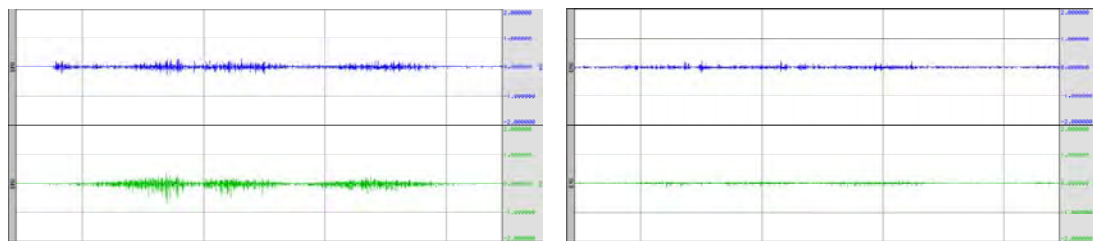

Figure 7. Examples of EMG on midst of under the chin. Left is stick type and right is pen-grip prototype, from the same subject. Upper row is flexor digitorum superficialis; lower row is flexor digitorum profundus. 1 tick on *y*-axis is 1mV. 1 tick on *x*-axis is 2 seconds.

Result of pressure to face measurement: As shown in Figure 7, Pen grip prototype has smaller pressure.

Pressure integral values (mV×Sec/500(Hz)) of 2 shavers (sum of 7 sites) were compared with measurements of 7 participants. The ratio between pen grip prototype and stick (averaged between subjects) is 0.15. Thus, 85% pressure reduction was shown on pen grip prototype.

Statistical distribution of difference between pen-grip and stick was along standard distribution. Thus, we had tested with paired t-test. As the result of the test, difference of pressure integral value between two shavers is also statistically significant ($p<0.0001$).

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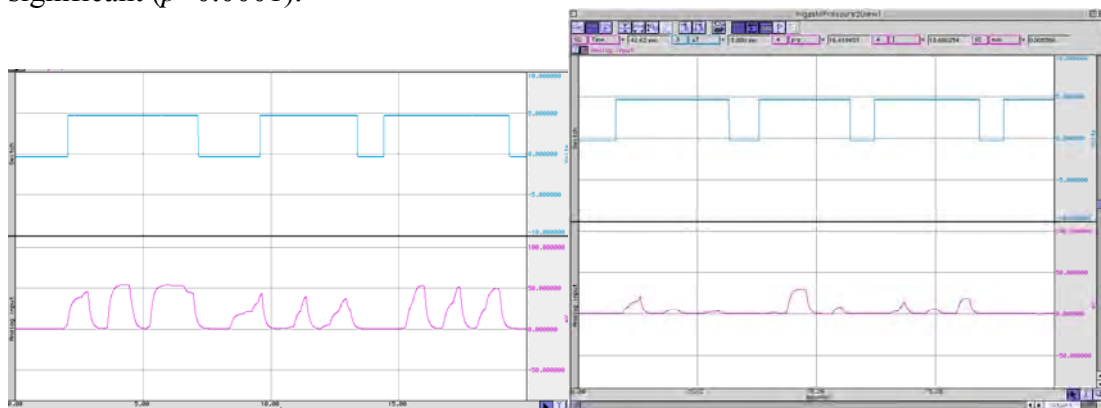Excellence; 20-22 August; 2008 in Helsingborg; Sweden

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Figure 8. Example of Pressure to the face, midst, right and left of under the chin. Left is stick type and right is pen-grip prototype, from the same subject. 1 tick on *y*-axis is 50mV.

8. RESULT OF SHAVER EXPERIMENT AND THE PRODUCT

From the experiment, we obtained the result that pen grip prototype reduced 22% of forearm EMG and 85% reduction of pressure to the face. Statistical tests have shown the significance of reduction. Then development of the pen grip type shaver was confirmed.

The new pen-grip shaver was launched in March 2008, and has large sales in fairly high price (around 60 Euro).

Figure 9. Commercial realization of the pen-grip shaver (SANYO SV-GS1)

9. CONCLUSION

We have shown practical case examples of improvement with Kansei ergonomics, through the commercial product development. Consumer potentially demands both scientific evidence and attractiveness of the product. We believe Kansei ergonomics is indispensable methodology for successful product development.

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A development of user interface on a new model of automatic washing-drying machine

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Abstract

Purpose – About one third of all automatic washing machines sold in Japan in 2007 had built-in dryers. The operation of the machines can be difficult because of the many functions it offers. The aim of this study was to improve the usability of a new model of washing machine.

Methodology/Approach – The authors conducted usability experiments in both the planning and preproduction phases of the new Sanyo AWD-AQ3000 prototype, comparing it to the conventional model. The subjects were asked to set the machine to perform the designated washing tasks using the two simulator and preproduction panels. The time and the sequence of steps to complete each task were recorded along with a subjective 5-point irritation score for each subject. All operations were recorded on video tape. The hierarchical task analysis was used to determine the incorrect steps. The new model using the improvements based on the results was released in February 2008.

Findings – Based on the results of the analysis at the planning phase, we decided to use the control knob to alleviate the operational steps and irritation score, and isolate the mode-selection buttons from the others. The locations of the start button and the control knob were also changed. The rotation of the control knob was consistently related with curved arrows pointed both ways on the horizontal display of LCD. Based on the results at the preproduction phase, in particular, changing the layout and adding the control knob was found to improve the results for the waterless function

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(disinfects and deodorizes using ozone instead of water) task, the average completion time of which was 34.5% that of the conventional model. Small problems noted in the experimental stage were fixed on the final production model.

Originality/Value of paper – The practical case example of usability improvement for the commercial product development, from the planning phase to the release was described.

Keywords *Usability, Automatic washing-drying machine, Hierarchical task analysis, Quantitative analysis*

Paper type *Research paper*

1. INTRODUCTION

About one third of all automatic washing machines sold in Japan in 2007 had built-in dryers [1]. Factors such as the increase in working parents and pollen allergy measures have contributed to the increase in sales of automatic washing-drying machines.

The operation of such machines becomes more complex and difficult as they offer more and more functions. Manufacturers provide more functions on automatic washing machines according to changes in family structure or customers' ideas of personal hygiene. For example, futons and blankets, which are rarely sent to the dry-cleaner, are usually washed at home using the heavy- or wool-washing programs of washing machines. Residents of apartment buildings often use a quiet-wash or time-delay program.

In addition, Sanyo Electric has added a new waterless cleaning program for disinfecting and deodorizing items such as leather-goods and stuffed toy animals, which have always been difficult to maintain at home.

As the number of functions increases, the users require simpler operating methods. The user interface must enable a wide variety of users to find the functions they need among the many available, and select the settings that are appropriate to their immediate washing requirements.

2. SIMULATED USABILITY EXPERIMENT

The usability of the control panel was a consideration right from the planning stages of the new washing machine.

2.1 Settings

This study examined the control panels of the conventional AWD-AQ2000 model and the proposed AWD-AQ3000 prototype, which incorporated a new control knob in a modified layout. Both panels were replicated in simulations using touch screens.

Seven women participated in the experiment. They were all over 30 years old and had used automatic washing machines before.

The experiment required the performance of 7 tasks: turning on the power, selecting either the wash or wash-dry mode, selecting the wash program, selecting the wash settings, setting the timer, setting the water-saving mode, and setting the "air-

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washing" (waterless) function. The instructions given to the participants were, for example, "wash the wool sweater without drying it" or "deodorize the leather shoes".

The subjects were asked to set the machine to perform the designated washing tasks using the two simulator panels. The time and the sequence of steps to complete each task were recorded along with a subjective 5-point irritation score for each
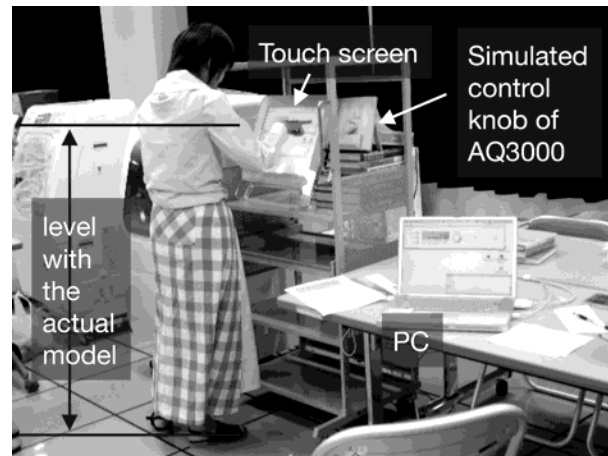

Figure 1. A snapshot of usability experiment on the simulators.

subject. All operations were recorded on video tape.

2.2 Results

The total irritation score for all participants and tasks was found to be significantly less for the new prototype than for the conventional model ($df = 1$, $F = 9.0645$, $p = 0.0032$). The task completion times showed no significant differences. The number of operations was reduced using the control knob. The subjects liked this since they had fewer buttons to push.

The hierarchical task analysis [2] shown in Figure 2 was used to determine the incorrect steps. The current choices were laid out horizontally and the subjects' sequence of operations were listed vertically. The points at which subjects got lost were found by comparing the results with the correct operating sequence.

Based on these results, we decided to use the control knob and isolate the mode-selection buttons from the others. The locations of the start button and the control knob were also changed.
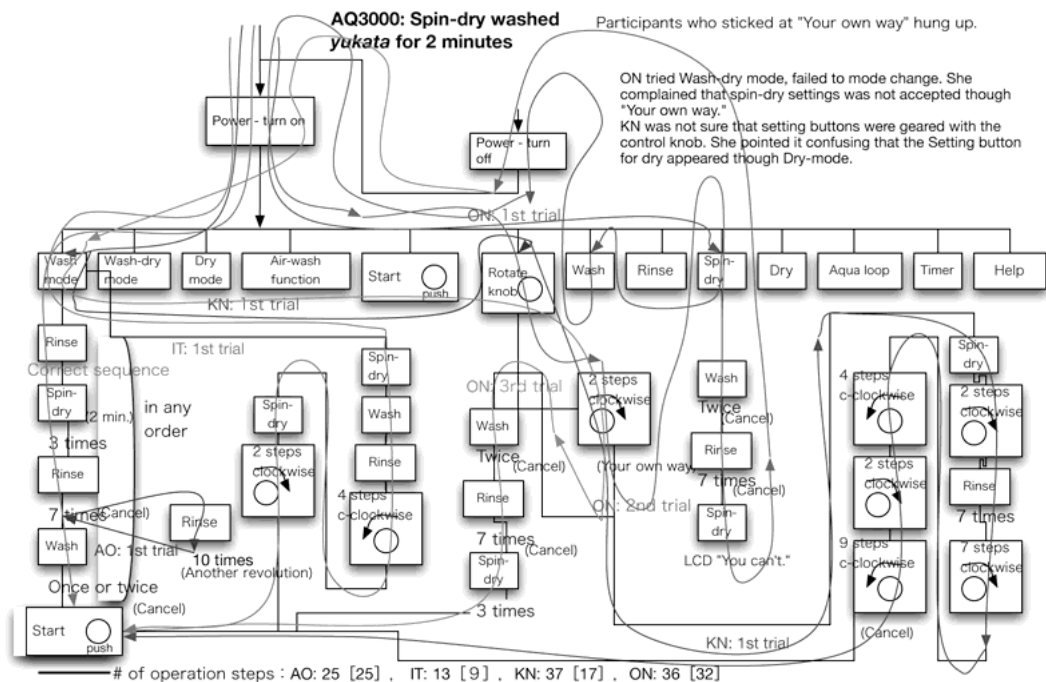
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Figure 2. An example diagram of hierarchical task analysis for the task "to spin-dry washed *yukata* (Japanese summer kimono) for two minutes." The procedure starts with "turning on power" drawn on the top of the diagram. Choice buttons and control knobs are drawn as connected boxes. The designed procedure and the participant's actually performed sequences were traced as lines with arrowheads.

3. RELATIONSHIP BETWEEN CONTROL KNOB AND DISPLAY

A general procedure was used to select the main flower, determine the final shape of the arrangement, and then to choose other flowers with suitable colors and shapes.

3.1 Settings and results

Before starting the usability experiments, we conducted a study of the relationship between the operation of the control knob and the display on the liquid-crystal display (LCD). The participants, 120 university students and teachers aged 20–61, were asked which program they expected to be indicated on the display when they turned the knob clockwise. Their responses were recorded for three types of display. The display types and number of responses are shown in Table 1. Display type A had two triangles pointing right and left, similar to railway station signs. Curved arrows on Type B also pointed both ways. Curved arrows on the Type C display were associated with the rotation of the knob. We adopted the Type B display since it got the most identical responses from participants, while the responses to Type C display were divided in almost half.

3.2 Comparison to other rotary controls

The suitability of the relationship between a rotating control and a quantitative display is one of the classic problems described in [3]. Wheel-type controls have recently been used on new devices such as the Apple iPod and the Sony HandyCam for choosing one item from a list. In those two devices, the association is completely rotated clockwise in 90 degrees; the displayed items are listed in a column and the

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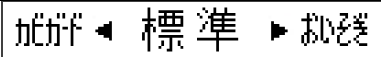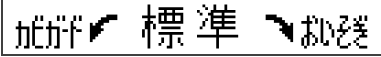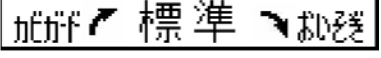Excellence; 20-22 August; 2008 in Helsingborg; Sweden

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pointer moves up or down when the user rotates the control wheel counter-clockwise or clockwise, respectively. The size and shape of our control panel were constrained by the hardware, so a new association between the control and display in a row had to be developed.

Table 1. Compatibility between display and the rotary control knob.
Question given to the participants: The course "標準 (*hyoujun*; standard washing)" displayed at the center of LCD is now focused. When turning the control knob a division clockwise, which course do you expect to be focused next, "カビガード (*kabi-gaado*; keeping mold out)" or "おいそぎ (*oisogi*; quick washing)"?

 Control knob

Shape of arrows	Display on LCD		
Type A			N.A.
Number of answers	21 (17.5 %)	96 (80.0 %)	3
Type B			N.A.
Number of answers	13 (10.8 %)	105 (87.5 %)	2
Type C			N.A.
Number of answers	61 (50.8 %)	56 (46.7 %)	3

4. USABILITY EXPERIMENT ON THE TEST MODELS
4.1 Settings

Fifteen male and female washing-machine users 30–61 years old, and 25 others approximately 20 years old, participated in the usability experiment. As shown in Fig. 3, they were asked to use actual models of the conventional washing machine and the improved prototype for the six specified washing tasks of the first experiment, excluding the use of the water-saving mode. The time, the sequence of operating steps, and the irritation measure were recorded.
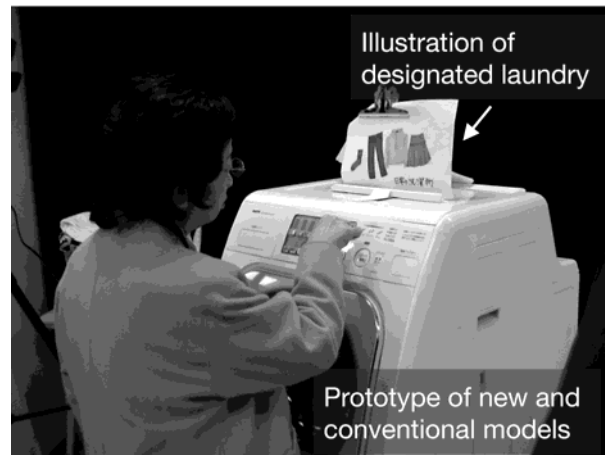
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Figure 3. A snapshot of usability experiment on the prototype models.

4.2 Results

The results for all six tasks on the new model were better than on the conventional machine. The overall performances for each measurement, for all participants and all tasks, are shown in Table 2. There was no significant difference in the total completion time between the two models, while total number of steps and the total irritation score were significantly reduced for the new model. We tested the difference in the measurements for the two models by the Wilcoxon matched-pair signed-rank test because we recognized that all of the distributions were not normal.

We then focused on the performance of the participants 30 years and older because they were the most like our target customers. We found that all measurements were significantly reduced for the new model.

In particular, changing the layout and adding the control knob was found to improve the results for the waterless function (disinfects and deodorizes using ozone instead of water) task, the average completion time of which was 34.5% that of the conventional model.

The results of the hierarchical task analysis for 15 participants aged 30 years or more showed there were still a few problems with selecting the correct washing program on the test model. Six participants missed setting the wash/dry mode first, even though this was better than in the case of the conventional model.

Some participants almost pushed the power button instead of the start button. The participants who discovered how to rotate the control knob for selecting the washing program and settings performed those tasks smoothly.

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Table 2. Comparison between new and conventional models with average measures over all tasks for all 40 participants.

Measures / Models	Average completion time	Average steps**	Average irritating measure*
AQ3000 (new prototype)	28.3 sec	11.8	1.9
AQ2000 (conventional)	31.1 sec	16.4	2.0

(*$p < 0.05$, **$p < 0.01$)

Table 3. Comparison between new and conventional models with average measures over all tasks for 15 participants who were 30-61 years old.

Measures / Models	Average completion time **	Average steps**	Average irritating measure**
AQ3000 (new prototype)	26.3 sec	11.2	1.8
AQ2000 (conventional)	34.9 sec	18.2	2.2

(*$p < 0.05$, **$p < 0.01$)

Table 4. Comparison between new and conventional models on the task of the appealing function "Air-wash." The measures were averaged over 15 participants who were 30-61 years old.

Measures / Models	Average completion time **	Average steps**	Average irritating measure*
AQ3000 (new prototype)	12.5 sec	3.6	1.3
AQ2000 (conventional)	36.2 sec	11.5	2.3

(*$p < 0.05$, **$p < 0.01$)

5. ADDITIONAL IMPROVEMENT

Small problems noted in the experimental stage were fixed on the final production model. The colored line on the start button was changed so that it should be easily distinguished from the power button. Rounded squares were added to the menu illustration on the control panel to indicate that the user should rotate the control knob. The final design is shown in Figure 4. The new model using these improvements was released in February 2008.

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(a) Body of the new model.

(b) Improved operation panel and the printings.

Figure 4. Released model of SANYO AQUA AWD-AQ3000.

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"Criteria Requirements of the European Business Excellence Model – A Suggested Approach"

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Abstract

Purpose – The European Business Excellence Model is nowadays a familiar framework, used for a spectrum of purposes, with the most frequent aim from its full deployment being the attainment of organizational success. The Model's requirements however involve abstruse management concepts and thus, there is, frequently, a significant variety within the suggested approaches to face the criteria requirements. Although, such integrated business excellence models should not necessarily be of a very prescriptive nature, allowing for deployment latitude among sectors and types of businesses, a more homogeneous basis of suggested approaches to the requirements maybe a welcome basis by both academics and business people.

Design/methodology/approach – Integration of the known references, stemming from both literature and best practices made available, to form a well defined basic framework of suggested approaches to the Model requirements.

Findings – The findings associated with sub-criterion 1a of the EBEM ("*leaders developing the mission, vision and culture*") are being reported in this paper.

Research limitations – Most of the relevant information describing current, applicable business practices is not publicly available, and has to be deduced mainly from responses to questionnaires.

Originality/value – Specific frameworks of suggested approaches for the well known Model requirements have not, as yet, been made available in the literature.

Introduction

There is no doubt that Business Excellence Models, such as the European Business Excellence Model (EBEM) and their basic characteristics are in the focal point of many studies. But an increased degree of variability in interpretation among practitioners, authors, researchers and academics is also noticed. The authors aim to compile a study, that resolve all questionable concepts referred to EBEM.

This research comes to answer questions, as what extend can we operationalize EBEM's requirements, have a common understand across industries and present model implementation pathways. A secondary target is to create a reference database with definitions of key terms involved, relevant literature, best practices and interrelations between EBEM and other Performance Management Frameworks, as well.

This paper focuses on sub-criterion 1a, as an attempt to explain this new approach of the Models requirements' operationalization.

The European Business Excellence Model (EBEM)

EFQM Excellence Model is a framework based on 9 criteria. The first five are "Enablers" and the last four are "Results". The "Enabler" criteria cover what an organisation does. The "Results" criteria cover what an organisation achieves. There are two approaches to explain the model. One approach is based on the idea that the results are caused by the "Enablers" and the second enablers are improved using feedback from "Results". The Model is based on the premise that:

Excellent results with respect to Performance, Customers, People and Society are achieved through Leadership driving Policy and Strategy, which is delivered through People, Partnerships and Resources, and Processes. (www.efqm.org). The EFQM Model is presented in Figure 1.
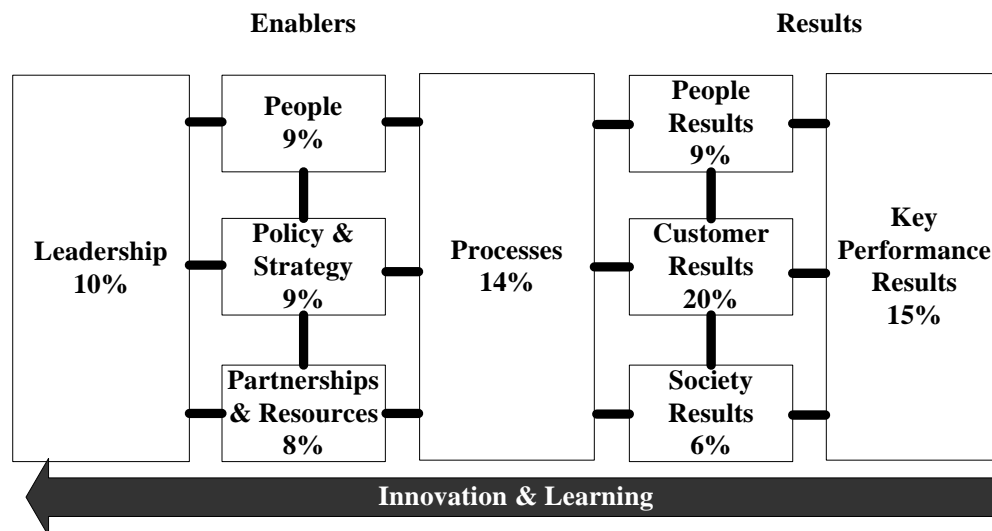

Figure 1: The EFQM Excellence Model (www.efqm.org)

The RADAR logic

In the heart of each Performance Management Framework there is an assessment and measurement tool. This tool for EBEM is the RADAR card. There are two forms of this card. The first one refers to the Assessment, Deployment, and Assessment & Review of the approaches of each Enabler-Criterion, when the second one has to do with Results by allocating the performance Measures or Indicators and their trend, targets, causes and comparisons with competition (EFQM Assessor Scorebook, 2003).

Criterion 1: Leadership

The first criterion of this Model is "Leadership". The authors in a previous research have concluded the differences between leadership and management from the business excellence view (Bohoris G., Vorria E., 2007). The output of this research was that while managers are the people to whom management tasks are assigned, and they achieve the desired goals through key functions of planning and budgeting, organizing and staffing, problem solving and controlling, leaders set a direction, align people, motivate and inspire (Kotter, 2001).

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According to the research the first criterion of the EBEM refers exclusively to leaders, as executives (Collins, 2001). Additional, one of TQM basic concepts and preconditions of an effective implementation of Business Excellence Framework is leadership commitment (Edgeman, Rodgers, 1999). According to EBEM, excellent organizations have leaders that "develop and facilitate the achievement of the mission and vision…" (Assessor Scorebook, 2003).

Criterion 1 of EBEM is divided into four sub-criteria. The sub-crierion 1a is the authors' first example to begin with.

Sub-criterion 1a: "Leaders developing the organizational Mission, Vision and Culture"

Basic definitions

It is always difficult to implement a requirement, when there are theoretical and not well-defined concepts involved. Before the presentation of all empirical findings, authors find crucial to study all the definition appeared at sub-criterion 1a of EBEM.

It is really important for organizations to develop a clear sense of their vision, mission and values at all levels to provide clarity about direction, priorities and behavior (Ancrum R., 2007). Leaders, who are responsible for this procedure, should align their own values and personal ethics with the organization's culture, in order to sustain all emerged advantages.

But lets study the basic definitions of sub-criterion 1a with more details:

- **Mission**

Mission is the organization's reason for being and its purpose (Evans J.R., Lindsay W.M, 2002). Mission statement is unique for every organization. According to a literature review, the components that must be included in a mission statements varies, i.e purpose, values/beliefs / philosophy, business strategy/competitive position, behaviour standards and policies, corporate level aim/goals, self-concept, public image, location, technology, concern for survival (Bart & Baetz, 1998).

Mission Statement Components

A mission statement should not be a slogan. It is a statement that indicates the organization's image. Sufi and Lyons (2003) compile a literature study for the important mission statement components. According to their findings the most common mission statement components are:

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Mission Statement Components	Frequency (%)
Customer Focus	95
Communication	90
Survival	86
Values	86
Employee care	76
Quality/innovation	71
Public image	67
Business	62
Location	43
Self-concept	33

Table I: Mission Statement Key Components (Sufi and Lyons, 2003)

A mission statement should convey a picture of future, appeals to the long term interest of all stakeholders, provide guidance in decision-making and allow individual initiative and alternative responses in a changing environment (Rigsby & Greco, 2003)

Another important factor about mission statement is to be short, easy to remember and written in plain words, so to be understandable. For example, Microsoft's mission statement is: *"'A computer on every desk and in every home"*. It is a short and promising statement. It refers indirectly to Microsoft's customers, i.e. people who use computers for work (desk) or for fun (home). It also gives the message that it is easy to obtain one computer, as Microsoft's mission is to "see" one PC in every home (Cousins M., 2005).

Developing a Mission Statement

Developing the organizations first mission statement is not an easy effort. It's a process with specific steps. Depending on the nature of business the process varies. Managers should examine all the unique characteristics of their organization and then implement the appropriate developing process. The common steps for the developing of a mission statement include the establishment of a working team, the elucidation of the basic elements, the articulation and the communication of the mission statement. There is always a review step that takes place periodically in order to revisit the statement and adapt the contemporary market evolution (Wickham, 1997).

Effective Mission Statement

A Mission Statement demands some preconditions, in order to work properly and be effective. First of all top management should support the whole attempt. Only when leaders are committed, understand and communicate this effort, is it possible to have the desirable results. Second, managers should not forget that the stakeholders' needs and demands is their top priority (Ireland & Hitt, 1992).

Mission Statement Failure

The main reasons why many times the mission statement is not successful are included below:

- There is a diverse and large set of stakeholders
- Mission statement has to conform with the status quo

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- Confidentiality is needed
- Mission statement is controversial
- Time spent with operation matter only (Ireland & Hitt, 1992)

Value of a Mission Statement

Besides the communication with customers and employees, effective mission statement can also be a valuable strategic tool. According to Mullano (2002), when top management is committed and involved, can help in the allocation of the key concepts of the Mission Statement, with elements from all organizational functions and management levels. Thus strategic targets are recognised and a appropriate set of measurements are suggested to evaluate the organizational performance.

- **Vision**

Vision is what an organization dreams to accomplish in the near future Vision statement is not true at the present. It's future targets that organization aim to achieve, beginning with the present mission statement and implementing the chosen strategic plans (Strange & Mumford, 2005).

Effective Vision statement

Collins and Porras (1991) compile a study on what are the basic questions a vision statement should include, in order to be used effectively. Concluding the studies analysis, the vision statement's key elements are the future orientation, clear purpose and directions, inspiration and enthusiasm, uniqueness and a balance between ambitious, high ideals and reality.

Value of a Vision Statement

One of the many benefits of an effective vision is the increasing easiness of performance measurement. A vision containing concrete goals makes it easier to track successes and identify early warning signs of ineffective programs. Furthermore, a clear vision statement highlights gaps in talent, funds, or facilities, Specific goals are useful as executives and managers concentrate on what resources they need but lack. Finally, employers that participate in developing a vision and mission statement are often more efficient and happier (Kilpatrick, Silverman, 2005).

- **Culture**

Culture consists of some combination of practices, values and beliefs, while it underline the appropriate behavior. Another definition of culture is: "a system of shared values defining what is important and norms, defining appropriate attitudes and behaviors..." (Detert et al, 2000)

Many researchers also use the concept of organizational climate. But there are controversial opinions. There are researchers who believe that culture and climate are exactly the same, while others believe that the differences refer to the level of analysis, the methodology followed and the theoretical foundations (Denison, 1996). However, EBEM refers to culture of excellence, which includes all the norms, values and beliefs needed for a successful journey to excellence.

Value of Culture of Excellence

Saffold compile a study (1988) in order to prove the strong linkage between culture and performance. He believes that cultural change can affect the performance measurements. Suggested measures are about

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climate formation, organizational learning, behavior control, strategy formulation, social efficiency and leadership.

Adopting the new culture norms is not easy. Employers feel insecure and resist change. Only when leaders act as role models, be open and inspire trust, can this organizational culture transformation become a reality (Strebel, 1996).

<u>Values</u>

Corporate values are the basic principles that guide all of an organization's actions. Managers should understand the different types of values, so they are meaningful and not just some slogans on a wall. According to Lencioni (2002), values can be separated into the following categories:

- <u>Core values</u> – deeply ingrained principles used for guidance and often reflect the owners' values. They must be maintained at all costs
- <u>Aspirational values</u> – values that the organization need to succeed in the future. These values need to be carefully managed to ensure that they do not dilute the core.
- <u>Permission-to-play values</u> – the minimum behavioral and social standards required of any employee. They never help to distinguish the organization from its competitors as they vary a lot.
- <u>Accidental values</u> – values that arise spontaneously without being cultivated by leaders. They can have a positive or a negative affect on the organizational culture.

Many studies have been made for evaluating the relevance between organizational culture and effectiveness. Denison and Mishra (1995) concluded in their study four traits of culture in an empirical model, that includes external and internal orientation with critical factors as change and flexibility, stability & direction.

This empirical model that align mission and organizational culture is shown below:

	Change & Flexibility	Stability & Direction
External Orientation	Adaptability	Mission
Internal Orientation	Involvement	Consistency

Figure 2: Empirical Model of Culture Traits (Denison and Mishra, 1995)

The second part of this paper refers to a presentation of bibliographical and empirical approaches to sub-criterion 1a of EBEM. Namely some methods on <u>how</u> leaders develop the organization's mission, vision and culture, will be presented and discussed.

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Approaches to sub-ctirerion 1a of EBEM

EFQM has recently released a publication (2001) about some tools being used to approach EBEM (www.efqm.org/excellenceone). Among the suggested tools there are two processes about the developing of a mission and the vision statement. The steps of this process are:

1. Decide whom to involve
2. Brainstorm what the organisation is doing
3. Define 2 to 3 competencies that are critical
4. Define customers
5. Define where the organization operates (geographically & cyberspace)
6. Build a first draft, that should be forward looking and credible
7. Test reactions within the organisation.
8. Communicate the mission (via email, organizational paper, intranet, etc)
9. Observe reactions
10. Review if it is necessary

On the other hand, according to EFQM toolbook, creating a vision statement involves the following steps:

1. Identify all the stakeholders
2. Define a time horizon.
3. Brainstorm the vision specific to each of the stakeholders.
4. Develop the sentence that will be your vision statement for each stakeholder.
5. Ensure that the vision statement, as a whole, is consistent.
6. Communicate the mission (via email, organizational paper, intranet, etc)
7. Observe reactions
8. Review if it is necessary

Oakland et al (2002) suggested another similar approach about the development of a mission and vision statement. They suggested that managers should conclude a draft mission statement and after they communicate it to all stakeholders, go forward with the appropriate changes and finish with all the revisions, made after team meetings, they record the final statement as part of the Quality Management System.

Another approach to sub-criterion 1a comes from Lever Faberge Ltd (part of Unilever). It's a company that is no strange with performance evaluation and self-assessment. Although the factory department has won a lot of awards, the environment continuous to change, i.e. increased competition, demanding customers, etc. In order to face those changes, managers have decided to adopt a new methodology named "strategy into action". They recognized that the real challenge lays in bridging the gap between drawing up the strategy and communicating it to every employee. This methodology involves the development of organizational mission, vision, critical success factors and the implementation of all action plans to the shop floor with everybody's participation When everyone feels equal to each other and empowered to express its opinion free, a clear mission and vision statement can de developed and it's much easier to conduct a framework of activities aligned to realize the vision.

According to Lever Faberge's managers, this methodology has results, as turnaround in customer service performance, manufacturing innovation and in the culture of the organization. They now underline that everybody's participation counts a lot in performance evaluation, improvement and sustainability (James, 2005).

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After studying organizations that have applied for the three EBEM Excellence Levels in Greece (www.eede.gr), one of the most common approaches to sub-criterion 1a is shown in figure 3.
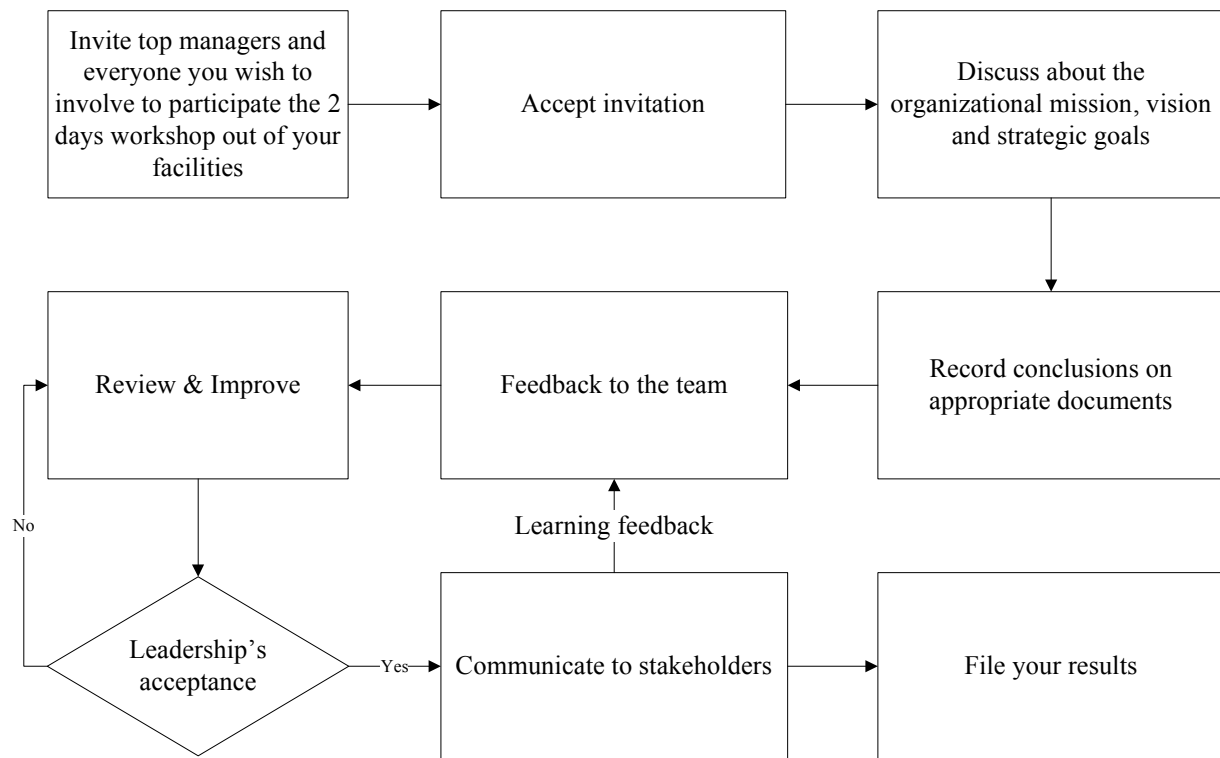
Figure 3: "Workshops to develop the organizational Mission and Vision"

"Radarise Best Practices"

The approach with best results for the organization's performance regarding to requirements of sub-criterion 1a, is called Best Practice. As mentioned above performance evaluation is made with the RADAR logic. Thereby, each approach must be evaluated for its soundness, integration, implementation with a systematic way and its measurements, learning and improvement topics.

Authors suggest a new unique method to help managers assess each approach that is developed in order to satisfy the EBEM requirements. According to this method, managers have to answer the 7 W's questions about the suggested approach, i.e., who, when, where, what, which way, to whom and which other way. The next step is to examine the approach's rationale, if it is a well-defined process, and finally if it meets all stakeholders needs. At the same time the suggested approach should be integrated, namely examine if it supports policy & strategy and is linked to other approaches.

In order to check the approach's deployment, managers have also to examine its implementation path and its systematic deployment in a structured way with well-defined methods. Furthermore, they should evaluate the approach's effectiveness, its deployment efficiency and the appropriateness of the measurement framework. Finally, they shouldn't forget to recognize best practices, identify improvement opportunities and organize action plans (Assessor Scorebook, 2003).

Conclusions

EBEM is the most known framework for self-assessment in Europe. The last decade greek organizations began their journey to excellence, as well. Over 80 Greek and Cyprian organizations have already applied for the three levels of excellence based on EBEM.

The next step of this research is the development of a questionnaire addressed to organizations that use EBEM as a self-assessment tool. Questions about the mission and vision statement and the organizational culture and how they are developed, will reveal the gap between the empirical approaches and the ideal best practices.

As it is mentioned above, one of the research's aims is to establish a database of best practices that satisfy the Model's requirement. Further future study will conclude this target, as many organizations in Greece recognize the EBEM's contribution, and adapt this framework as a self-assessment instrument. Shortly more data will be available to fill in this useful database of best practices.

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The identification, analysis and comparison of different ways and approaches in measuring and evaluation of organizational excellence

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Abstract

Purpose: The basic purpose of the present paper is to provide readers with a comprehensive description and comparison of different techniques and models, aiming at evaluating levels of organizational excellence. In Europe, the EFQM Excellence Model is unquestionable the leading force, but the multidimensional subject of attaining excellence can not be solely captured. A variety of other approaches have been developed –some of them were inspired from the EFQM's shortcomings- and are examined thoroughly.

Design/Methodology/Approach: This research is based on a majority of research and conceptual papers, public documents and our own experience.

Findings: The first part of the paper presents the core concepts of the EFQM Excellence Model and its suitability for measuring the levels of business excellence is being demonstrated. The second part is dedicated to the exploration and presentation of alternative ways for attaining the highest possible levels of excellence, while, in the third part a comprehensive comparison among them is being conducted. Finally, in the fourth part, the basic findings are summarized.

Originality/Value: An inclusive review of the major ways under which significant levels of excellence and sustainable success can be achieved.

Keywords: Business Excellence, European Foundation for Quality Management, diagnostic self-assessment, organizational structure.

Type of paper: Review paper.

Introduction

The European Foundation for Quality Management was officially established in Montreux, on the 19th October 1989. The emergent organization had to successfully accomplish a set of strategic goals, the most important of which was the development of a European Quality Award that would act as the European voice against the already established American one, the Malcolm Baldrige National Award. The members of the EFQM Award Committee were so confident about the final outcome of their efforts, that they were thinking of the upcoming award as the bridge, through which the philosophy and the principles of TQM would enter the European land.

The top priority for the EFQM members was the development of a model, which would have substantial differences in comparison to the American one and the reason was obvious; it was necessary for the embryonic model to become universally acceptable as a totally different approach for attaining business excellence compared to the existing standards and beyond dispute, this would lead the TQM initiative into a new era.

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The decade of 80's was marked by the vertiginous development and flourishing of the Japanese economy, which managed to become the prevalent one. The international markets were highly affected by the predominance of the exported Japanese products and felt, that their long-run survival was jeopardized. The first market which experienced the severe consequences from the dynamic entrance in the global field of the Japanese products was the one of the North America and thus, was the first that reacted, by trying to realize the extent of the problem, through comparative analysis and benchmarking.

In the above framework, Europe was remaining aloof and it was clearly lagging. The need for a radical change was apparent and the initiative was taken by some of the 14 largest European companies having the bounteously support of the European Union. That was the starting point for the genesis and introduction of the EFQM and its child, the EQA, which was later renamed to the "EFQM Excellence Model".
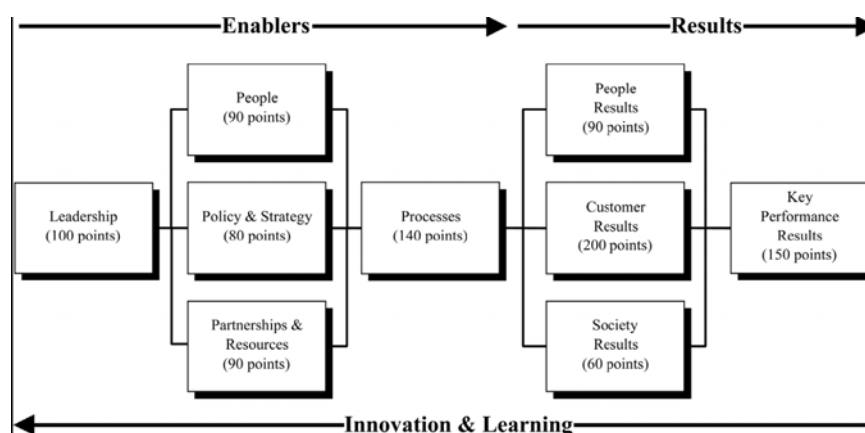
Figure 1 – The EFQM Excellence Model

According to Figure 1, the EFQM Excellence Model consists of 9 criteria which are divided in two main categories; the enablers and the results part. Enablers comprise the set of activities that a company develops and implements on a daily basis in order to produce results, which will satisfy the needs and expectations not only of its customers (customer results), but also of its stakeholders. Stakeholders form a wide category which includes the human resources (people results), the local community inside which the company operates and also –under a broader view- the global society (society results). Besides, results should also satisfy strategic business and image goals (Key Performance Results).

By taking a closer look to the model, we can assume that there is an internal structure between the set of the enabler criteria (Bou-Llusar, J.K., Escrig-Tena, A.B., Roca-Puig, V., Beltran-Martin, I., 2005). Its graphical illustration demonstrates that effective leadership is a prerequisite for efficient policy and strategy and drives human resources management as well as partnerships and resources. The appropriate combination of these factors will lead -through excellent processes- to the achievement of excellent results. The same rational is also identified in the set of the results criteria; specifically, excellent Customer, People and Society Results will lead to excellent Key Performance Results. Besides the implied logic of the existence of an internal structure in each of the model's domains, the basic idea behind the EFQM Excellence Model is that corporations can achieve excellent results, only through excellence in the enablers' domain.

Figure 1 also reveals that there is an analogical relationship between the total weights allocated to each domain. The total set of the Enablers is worth a maximum

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of 500 points (in a scale from 0-1000) and the same stands for the Results. According to Tito Conti, the basic reason which forced the members of the EFQM Steering Committee to choose this weighted system, stems from a fundamental principle of the TQM's philosophy, the one which implies that the customer should be placed in the centre of a company's interest; saying it in a different way, the voice of those who experience on a daily basis the Results produced through the implementation of the Enablers' set, has to be rewarded with exactly the same weight as the set of Enablers, which are highly dependent to the assessors' judgment.

Benefits and shortcomings revealed by the use of the EFQM Excellence Model

The application of the EFQM Excellence Model for self-assessment purposes provides the company with a thorough evaluation of its current situation and enables it to identify the biggest performance gaps and prioritize its corrective plans towards improvement. Besides, the EFQM Excellence Model is considered to be the binding link between the company and the principles of the TQM's philosophy, since, the major principles and concepts of TQM's philosophy are appeared in clear and accessible language within the framework of the model (Ghobadian and Woo, 1996)

Since 1991, the EFQM Excellence Model has turned to be the most commonly used model among the companies conducting self-assessment and it has also been empirically verified that the application of its principles has a positive effect on corporate performance (Kristensen and Juhl, 1999; Singhal, 2002). Essentially, when its principles have been implemented effectively, performance improves in both short and long time periods (Boulter, Bendell, Abas, Dahlgaard, Singhal, 2005).

However, practice of the model has revealed some major shortcomings, the most important of which is that its global suitability is questionable and many quality experts have argued that the development of a universal business excellence model (UBEM) is required. A second problem arises when implementing the model, because there seems to be an imbalance between the human dimension and management based approaches (Dahlgaard, 2003a). This problem is also related to a tendency to focus on tangible and objective aspects while underestimating the more intangible and subjective aspects (Dahlgaard&Dahlgaard-Park, 2007; Dahlgaard-Park, 2008). Thus, the need for the development of a different approach focused more on the "soft" organizational aspects is increased.

Another problem stems from the unreasonable high importance that companies have placed upon the award dimension of the model, which has forced them to spend more money to enhance the quality of the application report than to improve the quality of their company. As a consequence, the self-assessment approach is often an award based approach and clearly, the two dimensions of the model should be distinguished. It becomes evident, that there is a need for developing a different model – probably based upon the structure and the principles of the EFQM model – focused solely on the self-assessment procedure and through which, on the attainment of organizational excellence.

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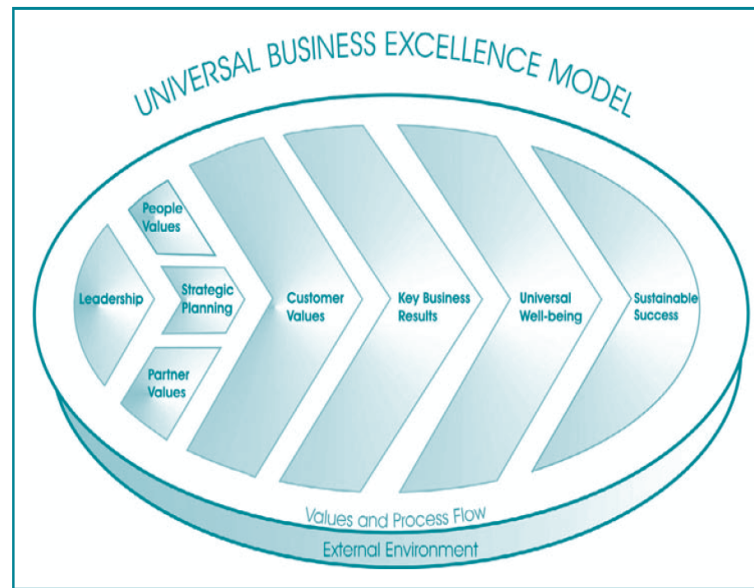## Alternative approaches and methods for measuring organizational excellence

Today's business world is mainly characterized by fierce competition, need for high production levels, customers' demands for products and services of superior quality and fast delivery, but also, for increased pressures stemming from both the legislation and the local community, according to environmental protection issues and the firm's contribution to the development and well-being of the society. Consequently, the need for attaining superior levels of excellence has become more important than ever and thus, a variety of methods, frameworks and models have been developed. The basic aim of the present article is the presentation and comparative evaluation of the most important among them.

The Universal Business Excellence Model

The EFQM Excellence Model together with the Malcolm Baldrige and the Deming Prize are the most popular and widely accepted Business Excellence Models -BEM's- . The main differences between these prevailing BEM's are related to the fact, that each of them is based on unique characteristics that stem from the different beliefs and cultures arousing in different countries and continents in which each model is developed or mostly applicable. This characteristic combined with the individual needs that each company has, tends to transform the above mentioned BEM's to nationally applicable models with limited potential for a more universal usage.

Furthermore, the majority of BEM's are intent to the enhancement and maximization of the profits and the worth of the company. However important this goal might be, it shouldn't be regarded as the final target, but as one among many intermediate goals, as one more step in order to come closer to the truly final objective, which is the long-run satisfaction of the needs and desires of the global community (principles which are apparent in the Vedic philosophy). Through the short-termed point of view, a company will be able to achieve individual wellbeing while, through the long-termed one, a company will manage to attain universal wellbeing and sustainable success.

This is the basic premise upon which the idea behind the development of a Universal Business Excellence Model –UBEM- was based. The resulting model will – according to the writers, (Sharma & Talwar, 2007) -include all the advantages provided by the existing BEM's together with the principles of the Vedic philosophy, and thus, the integration of the West practices with the East culture will help companies to achieve a long-run prosperity and survive in the international and highly competitive market field. The graphical illustration of the UBEM is presented below:

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Figure 2 - The Universal Business Excellence Model

If we closely examine the above presented model, we can realize the pivotal role of the leadership, the fundamental block of which is values. Leaders should exhibit high levels of commitment towards a continuous improvement philosophy and should seek through their daily actions to become role models for the others. The development of a value-driven culture that will be communicated and accepted throughout the organization, will positively affect all the major stakeholders of the company, expressed by the fundamental elements of the UBEM (e.g. people values, partner values, customer values and key business results). This explains the catholic influence of values and process flow element, the application area of which extends to the whole model. Besides, it also drives the alignment of the company's vision with the universal well-being for ensuring attainment of sustainable success.

A key difference between the existing BEM's and the UBEM lies on the flexibility that characterizes the latter one. When talking about the major shortcomings that BEM's face, we highlighted the unsuitability of such models becoming universally applied because of their standard nature which can not capture the uniqueness of each individual company. What differentiates the UBEM is the existence of an extra layer which is being applied throughout the model. This extra layer ("External environment") enables the UBEM to integrate with the culture and business environment of the country where it is to be used (Sharma & Talwar, 2007). Besides, there is no standard weight assigned to the criteria of the model. Each company is allowed to adapt the principles and philosophy of the UBEM to its own internal system and determine the weight structure according to the magnitude that each criterion-element has, taking into consideration its individual characteristics and needs.

The basic outcome revealed during the evolution of the UBEM, is the extraction of four factors, namely "Universal well-being", "Building learning organization", "Values-based governance" and "Enhancing profits and growth" and each one of them represents a fundamental building block of the UBEM. The first three stem directly from the principles of the Vedic philosophy, while the fourth one is evident in the majority of current BEM's. Consequently, this is an indicator that the structure of

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UBEM integrates the common features among BEM's together with the universal laws emphasized in the Vedic philosophy.

Methodology for assessing Quality of the Organization of the formal social unit (MUKOZ technique)
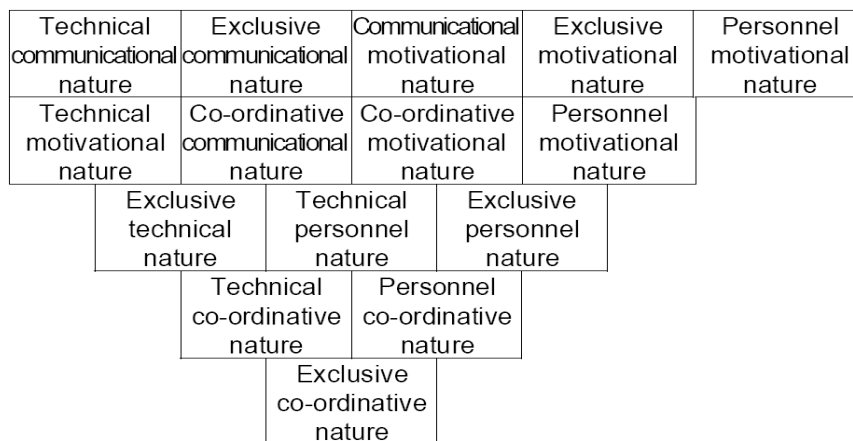
The concept of Quality Cost was first appeared in the 1950 and it was traditionally referred to the cost of inspections. Quality costs are all these costs derived from the fact that things rarely are done properly right the first time. Quality costs are subdivided into 4 main categories, namely prevention, appraisal, internal and external failure costs (Dahlgaard, Kristensen, Kanji, 2002; Feigenbaum, 1956). However, there are two additional quality costs categories, which are neither detectable nor quantifiable or recordable. These kinds of costs are invisible and responsible for about 70% of the total quality costs. The iceberg theory was developed in order to explain this phenomenon and it is also a reminder to managers that they should always look beneath the surface and beyond the visible parts.

The iceberg theory can also be applied in today's business world; there is no doubt, that financial results are one of the most important parameters with regard to the evaluation of the performance of a given company. The basic drawback associated with these results, is that they include information representative of the company's past. However, when the objective is the evaluation of the excellence levels, information in relation to both the present and the future condition of a company needs to be considered. Consequently, we can think an enterprise as an iceberg, which is comprised by its visible (financial results) and invisible parts which consist of many factors whose impact on the long-run viability of the firm is a multiple of the corresponding impact caused by the financial results.

At this point, the main question arouse is, "which are these factors"? According to Lipovec (Pregeljc, 2004), the organizational structure is what shapes the invisible part of the iceberg and in this framework, the MUKOZ model was born. The fundamental blocks which compose and explicitly define the meaning of the word "organization", are according to Lipovec, the relationships. The term "relationships" is not solely referred to the interpersonal relationships developed between the employees of a company or, between employees and people outside of the company, but it includes as well the effectiveness of communication channels established throughout the company.

It also includes a detailed determination of the needs for all the positions emanated by the organizational chart (technical relationships). The knowledge of both the needs of a particular position and the capabilities of a particular employee, will lead to the delegation of tasks to the most suitable people (personnel relationships). Furthermore, an important aspect of the relationships and an indicator of the extent of the organizational consistency of a company, are the coordinative relationships. Finally, employees' empowerment and involvement through the development of a human-oriented culture is the key towards a sustainable success (motivational relationships).

The above mentioned relationships consist the fundamental blocks upon which the term "organizational structure" is based; however, the complicated nature of a company can not be solely captured by these 5 basic relationships and thus, the combination of them in pairs with all the others is also used, and this results to a model, composed by a total set of 15 relationships.

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Technical communicational nature	Exclusive communicational nature	Communicational motivational nature	Exclusive motivational nature	Personnel motivational nature
Technical motivational nature	Co-ordinative communicational nature	Co-ordinative motivational nature	Personnel motivational nature	
	Exclusive technical nature	Technical personnel nature	Exclusive personnel nature	
	Technical co-ordinative nature	Personnel co-ordinative nature		
	Exclusive co-ordinative nature			

Figure 3 – Organization as a structure of relationships

The basic premise behind the MUKOZ model lies on the development of a methodology for evaluating organizational excellence, by examining the 15 basic relationships through an evaluation of aspects of relationships or contextual factors. Contextual factors are (Pregeljc, 2004) particular elements appearing within different organization arrangements, influencing and defining the type of relationship. Aspects of relationships are different pictures or snapshots of organizational life, converged with the particular type of relationship.

In the MUKOZ methodology, we examine thoroughly the 15 relationships which compose the organizational structure of a company. These relationships are evaluated through the use of the most appropriate among the 49 conceptual factors or through the use of at least 3 aspects of relationships for each of the 15 fundamental relationships. After estimating the total score for each of the 15 relationships, we can move on to the next step, where we will use these scores in order to reach some general conclusions about the organizational excellence levels achieved by a given company. In MUKOZ methodology there are 6 indicators which have to be estimated for that purpose; each of them considers the organizational performance from a different organizational perspective and thus, an overall estimation about the organizational excellence levels will be based on the appropriate combination of the set of the 6 indicators.

The indicator of organization's value is a way of expressing the performance of a company by a single number. Despite the obvious shortcomings stemming for oversimplification reasons, this indicator can provide useful information when used appropriately. The major shortcoming related to the extensive use of averages scores, is that they tend to "hide" information according to the consistency of a company's performance during a specific time interval and this was the main reason led to the development of a second indicator, the indicator of organization's reliability.

This indicator shows for every aspect of relationship the dispersion of the given values in comparison to the ideal one. Consequently, it provides a framework for the evaluation of the stability of an organization but also an estimation of whether the company has decided to place an equal amount of effort in every factor that affects organizational excellence.

The indicator of organization's orientation is a way of identifying whether a company is a people or a product–oriented one. If we closely examine the excellent companies worldwide, then, we will understand that there is no such a perfect pattern of organizational structure. Many companies have managed to be successful in the long-run, by concentrating their primary focus on people, while others, by

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concentrating on products and processes. Thus, there is no universal law that governs the most suitable organizational orientation for a company.

The fourth indicator is that of organizational commitment. A very important factor for reaching excellent organizational levels is the investment of both time and money on human resources. According to modern organizational views, human resources are considered to be as important as customers and actually, they are renamed to "internal customers". Employees need to feel important for the company and if so, this will lead to higher levels of self-confidence and a sense of pride for working for this particular company. There are many ways in order to get employees involved and probably the best is through motivation and what this indicator measures, is the effectiveness of the company's efforts focused on motivating its people.

The indicator of organizational consistency is the most appropriate one, to reveal the effectiveness of (top) management. The EFQM Excellence Model – as well as other BEM's - highlights the central role of Leadership in today's business environment. Leaders are responsible for communicating the values and establishing a solid foundation based on a culture of respect, collaboration and teamwork. The resulting value for this indicator is more than a numerical number; it is actually the perceived level of management commitment to excellence and the evaluation of management's work and efforts.

The last indicator of the MUKOZ methodology, is that of informational supply. The need for developing appropriate communication channels throughout the organization and carefully removing the obstacles preventing information from reaching the receiver is undisputable. Communication is an essential part of almost every aspect of organizational life and an integral substance for organizational excellence.

To sum up, MUKOZ methodology provides a framework for measuring and evaluating organizational excellence through the assessment of relationships, which represent the fundamental blocks of every organizational structure. The theoretical background of the model is confirmed through the linkage between the MUKOZ methodology's findings and global, theoretical rules and this is an indicator of its internal stability.

The "4P" Quality Strategy

In today's business world, more and more organizations decide to devote much of their time and money for attaining "Organizational Excellence" and the new ''4P '' Quality Strategy was introduced as an alternative methodology for assisting companies' efforts towards this direction. According to the "4P" methodology, organizational excellence is the outcome of building excellence in 4P's in the following order: 1. People, 2. Partnership/ Teams, 3. Processes of work, 4. Products/ service products.

The journey towards building organizational excellence in a given organization will begin with the embarkation on the ship of the Leaders, who, as the captain on a cruise ship, will assume the responsibility to safely navigate the passengers to their destination. Leaders are accountable for the development of the mission, vision, values and ethics that will govern the organization during its life-cycle and besides, it's their responsibility to establish and continuously communicate and foster a culture of continuous improvement and organizational well-being. Leaders need to act on a daily basis as role-models, by practicing what they preach and thus, inspiring other employees to follow their paradigm.

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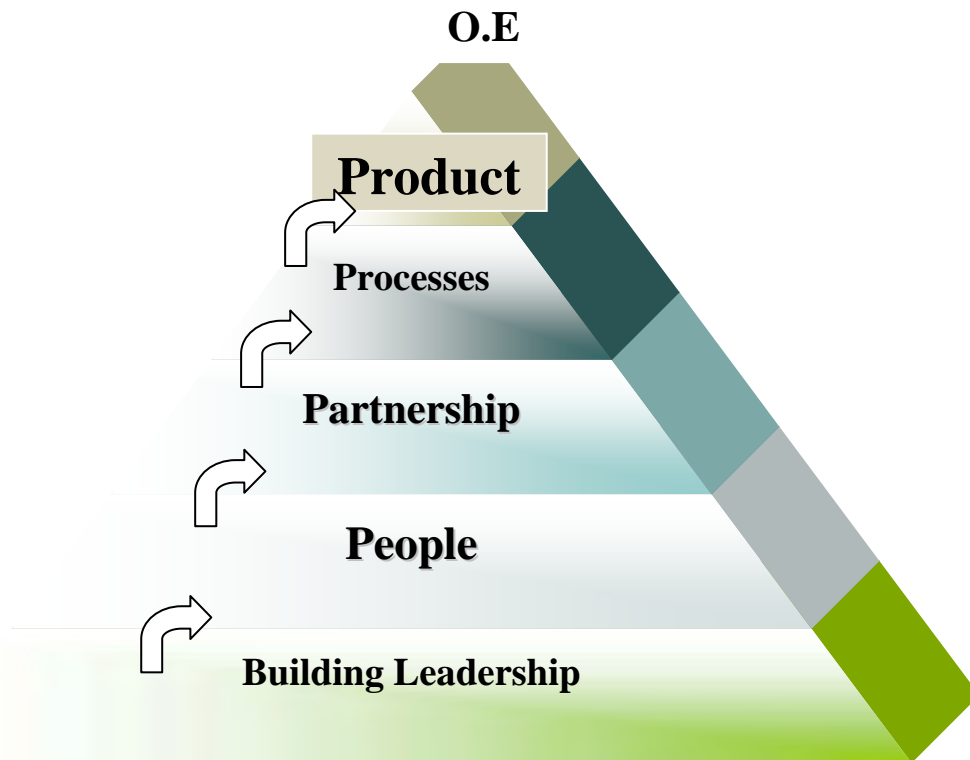Excellence; 20-22 August; 2008 in Helsingborg; Sweden

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The second step is devoted to building excellence to People. Having highly skilled and experienced employees is definitely an important factor for almost every company willing to survive in today's competitive market place but is not enough; the combination of the required skills together with possessing the right values and attitudes which are in line with those of the given organization is what really matters.

Partnerships represent the second of the 4 P's and building excellence to them is another necessary step for achieving organizational excellence. Collaboration and coordination are essential "tools" for a company and team-based rather than individual projects are normally the case in today's business environment. Each team consists of a small or large number of employees and thus, the excellence built in these people will inevitable be mirrored in its daily operation. Negotiation and communication skills together with respect for the differentiation between the members of the team, in terms of culture, religious and political views are essential elements for a team in order to realize its full potential and successfully accomplish its objectives.

With respect to the TQM philosophy, Processes are given a pivotal role in the daily operation of almost every kind of organization. Building Excellence in Processes, means building Excellence in almost every kind of aspect directly or indirectly related to the production of the products (services). Processes are influenced by the systemic factors (according to the diagnostic self-assessment model) or the rest of the Enablers forces (according to the EFQM Excellence Model) and thus, the excellent levels built in these factors (People, Partnerships) will affect the excellent levels achieved by the Processes.

The final P refers to the Products (or services) produced by a given organization. Production and delivery of products to customers, is the main reason for the existence of a firm. Customers are the final judger of the quality levels of a specific product/service and the basic aim of every firm should be to identify, meet and exceed their needs and expectations. Therefore, building excellence in Products yields to superior levels of customer satisfaction, which in turn may lead to superior levels of customer loyalty, which in turn is the primary key for the long-run survival of a company.

Given the direct influence that Processes have on Products (or services), building excellence to products is highly correlated to the excellent levels built in Processes, which in turn are highly correlated to the excellent levels built in Partnerships and People. Therefore, we can reach the conclusion that the relationship between the 4 P's is a pyramid-like one and figure 4 exhibits all the interrelationships and dependencies among them.

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Figure 4 – A structure for Building Organizational Excellence through Leadership and "the 4P's"

<u>**Organizational Self-Assessment**</u>

When the members of the Award Steering Committee presented the European award model, the competitive position of Western Europe was enhanced through the formal introduction of Total Quality Management as the basic infrastructure in order to develop, sustain and continuously revitalize a competitive advantage.

There is no doubt, that one of the most valuable "assets" possessed by a company is its customers and definitely, customer satisfaction has to be one of the highest priorities. Nevertheless, the distance between trying to satisfy the customer through the adoption of a customer oriented philosophy, by developing a systematic approach for identifying, understanding, meeting and exceeding customer desires and trying to "deceive" the customer by preparing "image documents" describing a perfect company and aiming at simply winning the award or be certified against the series of ISO-9000 standards, is quite long.

The underlying philosophy of today's Business Excellence Models is that they represent an ongoing journey to the world of quality by the ship named continuous improvement and the award-dimension is just a harbor. Unfortunately, more and more companies tend to misunderstand this basic principle and regard the award dimension as the journey and the self-improving process as the harbor.

Apart from focusing on the award dimension, companies also tend to blindly follow the model's suggestions (Conti, 2007). And if this sounds logical for award participation, it doesn't make sense when coming to the self-assessment dimension. The basic premise of self-assessment is that each company is a unique one; it differs from the others in terms of size, operating branch, management's maturity level, and

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socio-political conditions surrounding the organization. Consequently, the reality of a company can not be solely captured by a single model, undependably of how generally applicable that might be and thus, in order for a company to realize the full potential of the self-assessment process, adaptation of the model is needed. Saying it in a different way, diagnostic self-assessment requires a customized model.

On this ground, Tito Conti proposed a (diagnostic) self-assessment model which is based on the principles of the EFQM Excellence Model but also has some substantial differences, the most apparent of which, is the clear separation of the processes from the rest enablers criteria. Processes are being positioned exactly in the middle of the self-assessment model, as the intermediate part between the set of the systemic factors and the mission/goals area and act as the bridge that connects the two sides of the model.

One of the major shortcomings connected with the evaluation of the levels of excellence, is the intangible nature of some assessment criteria and thus, the increased degree of subjectivity. For example, leadership and people aspects are difficult to be evaluated based on international standards and different assessors coming from different cultures, will express very different opinions according to these aspects. Contrary to the set of systemic factors, processes are characterized by a tangible and measurable nature. Furthermore, processes have a direct influence to the company's results and the reason is that the primary output of a company (its products or services) is generated by processes. Systemic factors on the other hand, have a more indirect influence upon results. The graphical illustration of the diagnostic self-assessment model is presented below:
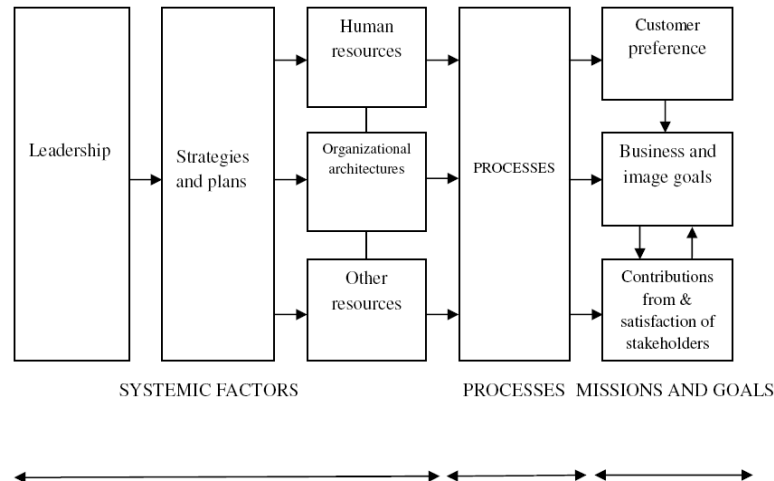
Figure 5 – The self assessment model proposed by Tito Conti

A second aspect that becomes clear from the schematic view of the model (except from the central role of processes) is the absence of any weighted structure and this constitutes the second basic difference between BEM's and the self-assessment model (after the division of the model in three autonomous but highly integrated categories) and for anyone familiar with Excellence Models this non-weighted version is at least surprising. Weights are part of a competitive system which is based on comparisons, aiming at the identification of the best among a group of participants. It is a necessary part of almost every kind of prize/award- oriented

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process for the simple reason, that only one can be selected as the competition vanquisher and therefore be nominated as the award winner.

But the basic premise of a (diagnostic) self-assessment process stands far away from the above philosophy. It is focused on self-improvement through the identification of the weaknesses, the prioritization of them at a decreasing order in terms of the severity of the consequences they cause, the identification of the underlying reasons that led to these poor results and finally, the selection and implementation of the most appropriate corrective actions.

So far, while speaking about self-assessment we have made an extensive use of the term "diagnostic". But what does diagnostic means and why is it so important? The word diagnostic derives from the Greek word "διάγνωση – (diagnosis)" which is a medical term and refers to the systematic procedure focused on the identification of the clinical symptoms of a patient and the root causes responsible for his/her unhealthy condition. The usage of the term can be expanded to many other fields and a diagnostic approach can also be applied to an "unhealthy" company. Therefore, the diagnostic self-assessment can be described as an on-going process for the identification of the causes responsible for "unhealthy" results or, using a more business-like terminology, for the performance gaps between expected and actual performance.

The need for a right to left approach is the third separating factor between the traditional award-oriented models and self-improving models. The starting point of a self-assessment process is the mission/goals area, the right side of the model where the identification of the major performance gaps takes place. Then, we move left, towards the middle part of the model – the processes – and finally, to the systemic factors. The root causes responsible for the poor organizational performance are identified and improved and new targets are set for the "right" area. After a specified period of time, the whole set of results is re-evaluated and the actual performance is compared to the expected. Performance gaps are identified and the effectiveness of the corrective actions implemented during the first right-to-left cycle is evaluated. The right-to-left approach is repeated, further corrective action is taken and new targets are set.

To sum up, the diagnostic self-assessment process is an organizational tool that can be used to verify the feasibility of the strategic macro-goals set by top management. However, as Tito Conti comments "if diagnostic self-assessment is to function correctly, a high degree of horizontal integration is needed, since the processes that play a critical role as far as results are concerned are usually cross functional." (Conti, 1997)

Comparative evaluation of the different approaches

In today's business environment, the need for products and services of superior quality is more intense than ever and thus, firms are on the horns of dilemma; they will strive to become excellent, or they will not manage to survive. Many frameworks have been developed providing alternative ways for achieving excellence and most of them embrace TQM concepts, such as the development of a customer-oriented philosophy or giving processes a pivotal role. Five primary "techniques" were presented above and in the following paragraphs, we will try to compare them and reach some general conclusions about their application area.

The Universal Business Excellence Model (UBEM) and the self-assessment model which was conceived in the brain of Tito Conti, do not prescribe a specific

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weighted structure. The basic advantage for the companies, is that they are able to adapt the model to their individual needs and decide which criteria are the most important ones and accordingly to weight them. On the contrary, both the EFQM Excellence Model and the MUKOZ technique have a pre-defined weighted structure which has to be followed as is.

The evaluation process is more or less the same for all the above presented techniques. A team of internal or external assessors site-visits the company and evaluates its performance against a pre-defined set of criteria and a final score is computed (or the biggest performance gaps are identified for the self-assessment case) Nevertheless, MUKOZ methodology differentiates itself in the sense, that descriptive levels instead of the traditional numerical scales are used. Consequently, assessors aren't left to their own judgment (even if it is the outcome of 20-years experience) as to what a particular grade or excellent level means and thus, differences between assessors' opinions are decreased and so does the subjectivity of the evaluation process. The use of descriptive evaluation levels ensures that the final scores calculated for each company are based on the same underlying pattern and thus, are comparable between each other.

All the five models have something in common; they all follow a pyramid-like approach, meaning that their first level (the lower level), consists of a number of sub-elements or sub-criteria (the 32 sub-criteria of the EFQM model or the set of the 15 relationships according to the MUKOZ methodology) which lead to a second level, less detailed in comparison to the first one (e.g. the 9 criteria of the EFQM Excellence Model, the 6 indicators of the MUKOZ methodology, or the 9 criteria of the UBEM) which in turn leads to a latent variable, to a third hierarchical level called "Excellence", which is positioned on the top of the pyramid. Consequently, the excellence levels achieved by a company have a direct relationship with the second hierarchical level of each model which in turn has a direct relationship with the third hierarchical level. These dependencies resemble the direct and the indirect relationships between results and processes and results and systemic factors respectively, according to the self-assessment model. In a quite similar way, the basic premise of the 4P Model is represented in a pyramid, in the bottom part of which is "Leadership" and on the top is "Organization Excellence", attained through the combination of the 4P's.

It has already been mentioned that self assessment is one of the most powerful tools that every company should have in its toolkit. Self-assessment is designed in order to help top management to embed a culture of continuous improvement throughout the company. What is really interesting however is that most of the 5 techniques can also be used as self-assessment frameworks.

The self-assessment dimension is inherent in the MUKOZ methodology. Low-performing indicators or relationships can be defined as areas for improvement and those indicators having the lowest score will be given the highest priority and will be the first to improve. Besides, each relationship consists of a number of aspects (or contextual factors) which are known to the top management and thus, improving the score of a given relationship, means going back to those elements and improve them. The major drawback associated with MUKOZ methodology is that it is structured on the basis that an organization is defined solely as a set of relationships. Consequently, the model itself is applicable only if you accept this definition.

The UBEM can also be used as a self-assessment instrument. When used for self-assessment purposes, it offers a significant advantage; it doesn't prescribe weights per criterion and thus, each company can take advantage of its flexibility. The

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procedures followed will be more or less identical to those when the EFQM is used as a reference model. After the major weaknesses have been identified, corrective actions will be defined and implemented according to the cause – effect relationships of the model. The UBEM is a universally applicable model and because of its focus on value-based leadership and wealth for the society, it may be more useful for value-driven and society-oriented organizations, composed by many subsidiaries all over the world and which have a consistent presence in the international markets.

The MUKOZ methodology is applicable in almost every firm which accepts the basic premise behind this model, that a company is properly defined as a set of relationships. Because of that, we believe that MUKOZ methodology may be more applicable in such companies, where the human factor is the most prevailing one and where all the transactions are more or less people-involving (services).

The self-assessment model proposed by Tito Conti is generally applicable and it is the best way for every company to realize its current situation and to think about its future and its long-run survival. The EFQM Excellence Model is one of the most used frameworks for measuring levels of excellence. However, companies fail to realize the full potential of the self-assessment process based on it, because they believe that it's only a prerequisite, an obligatory but unimportant step prior to the participation to the award competition.

Finally, the 4P methodology differs from the majority of the current BEM's, since it considers the human dimension as important and essential for the attainment of high levels of organizational excellence. The application area of this model is quite extensive and especially in those companies that are human rather than product oriented.

Conclusion

Our basic aim in the present paper was the presentation of 5 models, which all try to capture the complicated issue of evaluating business excellence from a different optical viewpoint. There are no general rules according to which of the above mentioned models is the most appropriate to be used in each case. Their suitability depends mainly on the purpose for which they are going to be used. For example, for companies seeking to realize their current situation, identify their major weaknesses and improve their performance, the use of the self-assessment model is the most suitable one. Contrarily, for a company aiming to be rewarded for its superior levels of business excellence, the application of the EFQM Model or of the UBEM sounds a more appropriate choice.

A second major finding was that almost all the proposed techniques can be used as self-assessment models; what has to be improved, is the way that companies perceive the process of self-assessment and the importance that tend to allocate on it. Self-assessment is not a contingent goal, but rather a permanent one and it's also highly correlated with the long-run survival of a company.

One major shortcoming related to the majority of the current BEM's is that even though they can be used by almost every company, in practice, however, their universally applicability is at least questionable.

To sum up, we believe that the journey towards excellence is an ongoing one and what is really important, is not how a company decides to reach the destination (e.g. which particular BEM will be used as a guideline), but the commitment – expressed mainly by top management- to reach this destination. Besides, the decision to embark on this journey shouldn't be customer-driven, but based on a continuous improvement culture, cultivated throughout the organization and in line with the

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company's vision and mission. Companies need to achieve high levels of business excellence because they believe in these, and not because they have to.

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Impact from the Resource-Based Approach on Strategy and Control; A new Framework for Empirical Research based on the "European Excellence Model"

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ABSTRACT

Originality/value: This paper may be considered as a valuable contribution to integrated studies of theories of change, developing and implementing strategy, decision making and management control.

Purpose: This paper discusses the potential use of the EEM model as a basis for a framework for integrated empirical studies of the resource based perspective on strategy and management control. The purpose is also to evaluate if EEM, in this somewhat revised version, can also be used for self-assessment with regard to a certain form of critical process analysis based on the PDCA-circle.

Methodology/approach: This paper has emerged as a result of reviews of pertinent literature taken from EEM, Management Control and theories of the Resource Based approach on Strategy (TGF, RBV etc). Further the model has been discussed as a potential model for empirical studies in a global company (in accordance with the Ph licentiate Thesis "Return of Resources; implications from the Resource Based Perspective on Management Control).

Findings: The results from this suggested modelling, partly based on a limited empirical study of critical process analysis, shows that this somewhat revised EEM model in a very interesting way, can integrate the resource based strategy and management control processes - in the face of company decision processes (ex ante/ex post). The model can therefore potentially be used as a new framework for empirical studies of the resource based approach on strategy and management control.

Paper type: This paper is regarded as a conceptual paper.

Key words: EEM, resource based perspective, management control, PDCA, strategy

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INTRODUCTION

Since the mid of 90´s resources – be consisted throughout explanations of strategic choices have gain ground within strategic research and it is today one of the most dominant paradigms within research as well as in practice. (Wernerfelt, 1984; Prahalad & Hamel, 1990; Grant, 1991; Barney, 1991; Newbert, 2007).

A resource-based perspective means that there is a certain focus on resources owned by the company or by its partners; and the various resources (and capabilities) that can explain company performance and long term growth/ or decline/. A resource perspective aims to give a picture of company resources before and during *decision-making processes* in company and business strategies. It also aims to describe *potential need for changes* in company organization (in systems and structures) in order to be able *to implement* value creating business strategies. A resource-based perspective also has a certain focus on m*anagement*, its /limited/ access to information and its capability to work efficiently and effectively with business strategy.

At the same time *management control* is regarded as dealing with the total operation of the company; the various stages or processes of the "value creation" of the company, and on various levels of the company. Various implications of a resource-based approach may be seen at the project management level, such as in R&D projects, and in total business management.

Management Control, or just "Control", is defined as `formal, information-based routines; systems and structures that management uses to keep or change patterns in the various activities of the company´ (Simons, 2000), primarily those activities that support management decision processes and actions when implementing business strategy.

The aim of this paper is to visualize an integrated model for resource-based strategy and management control in a model, the EEM, and to discuss some implications when using this model as a framework for empirical studies. So far, research from emoirical studies have only described, to a minor extent how this resource-based perspective on company strategy and control explains the development of the company (Henri, 2006),, and to a lesser extent strategy versus control, in this respect, has been studied within an integrated theoretical and empirical framework.

For future research one might therefore describe the problem as a need for a "new" theoretical framework that can view a resource-based perspective on strategy *and* control from a total management point of view; all this in order to enable empirical studies of the various processes and parts of a "whole", a "whole" that describes company development. The EEM-model seem to be a model that can visualize various parts of this "whole" and can be used as a valuable tool for analysis, reflections and also systematic self-assessment.

After a short introduction of the European Excellence Model (EEM) this manuscript discusses a) the resource-based strategy and its potential, theoretical implications from this perspective of strategy, of and on management control. Then the manuscript b) suggestsw a framework for empirical studies of the integration of strategy and control, a framework based

on this "European Excellence Model". Finally the manuscript briefly c) mentions the EEM as a potential model for use in self assessment.

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Based on this "non-descriptive" framework "the EFQM Excellence Model" ,or, more popular the "European Excellence Model (EEM)**Note 1/**or the "Business Excellence Model" (BEM)/ we briefly discuss the resource-based perspective on strategy and control as applied in various parts of the model.

Some empirical findings from a well known global company will be used as a reference to some diagnostic, as well as interactive, analysis and use of control systems, in implementing one resource-based strategy (innovation), as explored by Jean-Francois Henri (Henri, 2006)

In order to validate the use of the EEM model a limited empirical study was conducted in this global company. After this study the model was modified in order to make it possible to deepen the discourse in further empirical studies. This limited study was conducted in the companies *innovation and R& D processes*. The company chosen for this empirical study traditionally has a certain resource-based perspective on product strategies, ie on product development (effectiveness), product efficiency and process efficiency (both in R&D and related processes). *Product Development strategy* is therefore the basis of this resource-based, business strategy and therefore "high-lighted" in the model. (A market strategy with customer focus is also viewed in the original model) Some other exceptions from the original EEM, such as impact on organisational structure and on PDCA-related decision processes will also be mentioned from this "resource based" viewpoint.

The result of these empirical studies shows that the EEM model (though in a somewhat revised version) in a very interesting way, integrates a resource based strategy and management control processes in the face of company decision processes and showes how the company organises for create value and a sustainable competitive advantage. The model can therefore be used as a new framework for empirical studies of resource based strategy and management control.

The European Excellence Model

According to the European Foundation for Quality Management (EFQM) their "excellence model" is a "non-prescriptive" framework that recognises there are many approaches to achieving "sustainable excellence" of a company.

"The EFQM Excellence Model", here EEM, is described as a practical "toolbox" or a tool that can be used in a number of applications:

- As a structure for managing the company
- As a common base and language
- As a tool for self-assessment
- As a guide to identify areas for change/improvements
- As a form for effective benchmark with other companies

In this manuscript we will focus primarily on the first three characteristics.

We often associate this model and other models like this one with its potential to combine a number of "enablers", ie the company resources (and capabilities) with a certain number of indicators where financial results and value for prominent stakeholders are mirrored together. The EEM is more than that; it explicitly points to several *organisational dynamics* such as

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processes for a) value creation and b) organizational learning and it implicitly points to c) reformulating policies and strategies.

The EEM in its basic version consists of nine different parts:

- **Company Management and managing the company** (Managements access)
- **Enabler (4)):** Policy and Strategy ; Owners and partners Resources ; Employees ; Processes
- **Results (4)**: Advantage for People, for Customers, for Society *and* Indicators of company performance
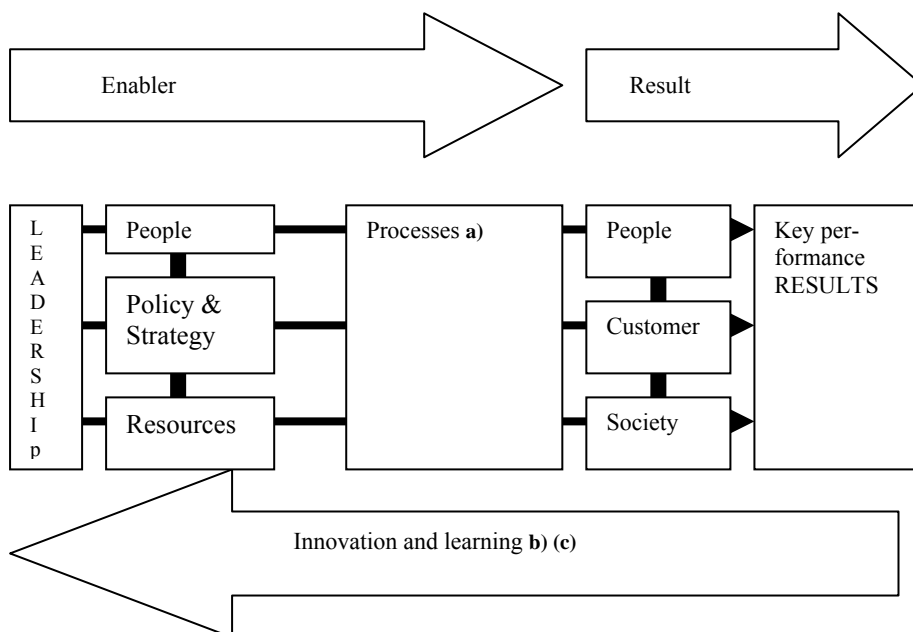
Fig 1 The European Excellence Model

Theory

In thisw section we briefly discuss the resources-based approach on strategy (taken from pertinent theories) and its potential implications of and impact on Management Control, with an emphasis on distinguishing between *ex ante* and *ex post* conditions and high-lighting the need for a new empirical framework.

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A broad review of literature on resource based perspectives on strategy (Newbert,2007) indicates the need for deeper and further empirical research from theories that emerged from "theory of the growth of the Firm" (TGF) (Penrose 1959) and "The Resource Based View" (RBV) (Barney, 1991).

The resource based view on strategy is discussed, within the present resource discourse,, with certain focus on companies´ *capabilities*, rather than on the (static) *resources,* that lead to competitive advantages and their implications on company "rents" etc (Peteraf, Prahalad & Hamel etc).**Note 6).** Little is done to *empirically* demonstrate how resources and capabilities are related in strategy formulation. A general framework for strategy (re-) formulation, grounded on the the resource based view, as a model for empirical tests is suggested by Robert Grant (Grant, 2001)

Newbert (Newbert, 2007) also calls for further empirical support for resource based view on company strategy; implications from a resource (and capability) perspective on companies value creation and competitiveness through innovations, value processing, organising resources, control systems and compensation policies etc. Newbert here calls for a formal assessment of empirical support of contemporary extensions of the resource based perspective, rather than on early incarnations of TGF or RBV (see below).

Implications on strategy

The resource based perspective rests on two major theories; TGF; "The Theory of the Growth of the Firm", (Penrose 1959) and RBV; "The Resource Based View" (Wernerfelt, 1985 and Barney, 1991). Compared to theories of market based strategies, these theories are seen as focusing internal strengths and weakness in organizational resources, showing how processes are managed and how the resources are allocated and deployed, all in order to obtain a sustainable or sustained competitive advantage. To obtain competitive advantage, resources have to be strategic and, according to Barney, valuable, rare, inimitable, immobile and in some contexts not even tradable. There are also *ex ante* and *ex post* conditions for competitive advantage (Peteraf, 1993); there should be a heterogeneous market; meaning no company can have or create the same resources or capabilities as another company. Rent is obtained through resource efficiency in processes and products and generated as Ricardian rents; i e limited supply or limited possibility to expand the resources gives a higher price. One *ex ante* condition, according to Peteraf (Peteraf 1993) is that management is *uncertain* of the resource situation in new markets or of the companys´ possible goodwill position (or that no information is available at all). The resource based perspective in a contemporary view should also include company elements such as structure, control system and compensation policies in order to fully ensure proper resource exploitation (Barney, 1997)

From s a contemporary viewpoint it is now also understood that firms have to demonstrate how to alter (in a dynamic way) the ingredients (resources and capabilities) in order to realize their full potential. An integrated model for resource based strategy (answering the questions of What? and How?) and a management control process (answering *ex ante* questions Why? For whom etc and *ex post* questions "What is the effect or result from the strategy ?) can therefore be viewed in a decision model like the PDCA-model. [1)]

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Very little empirical research is conducted when it comes to *implications of and on Management Control* from a resource based strategy and especially when concerning the /obvious/ integration between strategy and control (systems). Jean-Francois Henri (Henri, 2006) shows, through an extended empiri how four *capabilities* (ie innovativeness, market orientation, entrepreneurship and organizational learning) leading to strategies, are affected by *diagnostic* versus *interactive* use of a certain part of Management Control; the measurement system (PMS). No further empiri (and consequently no framework for empirical studies) about impact from (and of) resource based strategies, from the viewpoint of PMS or other control aspects, has been found in pertinent literature just yet.

This potential need for a new theoretical understanding accentuates the need of a model that can visualize the various parts of company development from a resource perspective. This has initiated an evaluation of a "new" framework for empirical studies. A certain "integrated" "processual" model for `strategy and control´(in terms of *ex ante* and *ex post* control), based on the PDCA elements 1) (se below) , has successfully been integrated into the EEM-model. Part of the model has been empirically tested and the model has been somewhat revised after that.

.With this somewhat revised, but still EEM-based developed model, we suggest a "new" model as a basis for development of a quite new framework for (resource-based) strategy as it integrates management control in a very interesting way. This /non-descriptive/ model as such points at, but does not though give any clear understanding of the dynamic events or emerging forces that develops the company. Those /time related dimensions/ are therefore viewed in connection with the description of the various analysed processes and settings and - with regard to this dimension of "time" – it is discussed as a potential improvement of the model.

PDCA 1)
The decision process

The PDCA-circle (Plan –Do-Check-Act) is described by Edward Deming (Deming 1995) and relates to various forms of decision matrices. In every stage of the PDCA circle one can define certain specific questions related to either the business *strategy* (The "What? and How?- questions) or to management *control* (The "Why? and For Whom? - questions). At a certain decision point, some questions are asked from both strategy and control viewpoint; the "Who?" and the "When? - questions.

1) PDCA refer to the Deming or Shewart activity cycle "Plan-Do-Check-Act" (Deming, 1995)

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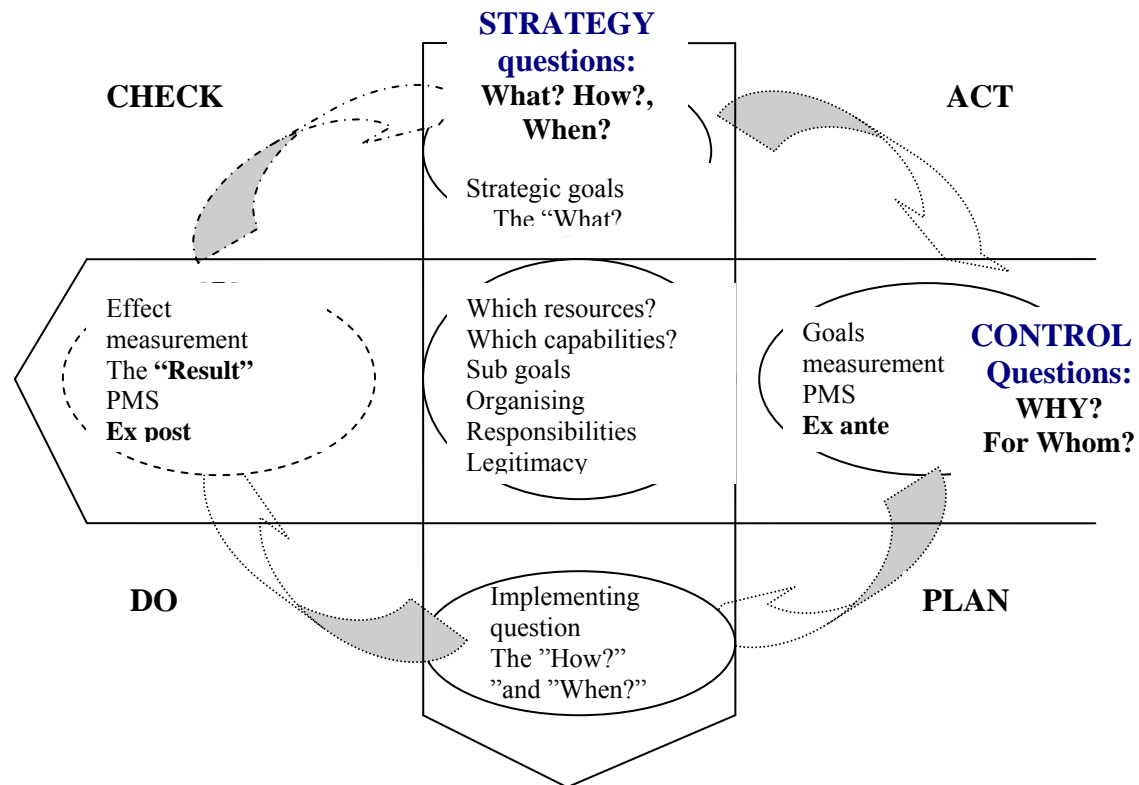
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Fig 2 Strategy versus Control – an integrated model with reference to the PDCA-circle.

A NEW FRAMEWORK

A "new" research framework for integrated Resource-Based Strategy and Management Control - as emerging in three steps (a-c)

This manuscript discusses the need for a new framework for empirical studies, and the possibility to use the EEM in order to fill this need; potentially possible especially when looking into literature studies within a number of disciplines. The implication on and from EEM on *Management Control* has been studied from relevant management control literature (Anthony, 1965,1980; Merchant, 1985,; Merchant and Simons,1986; Simons, 1991,) and is described in a number of dimensions **Note 3)** by Su Mi Dahlgaard-Park (Dahlgaard-Park, 2007)

Strategy is a key word in EEM. One path in this development from the basic version of EEM is the perspective on strategy where the enablers primarily focus on company´s internal resources (read also partners resources) rather than on the external view of resources. Therefore the application of resource perspective on strategy has its references to TGF (Penrose 1959) and RBV (Barney, 1996, Hall, 1991, Prahalad and Hamel, 1990 et al). The external view of resources, with its reference to the theory of resource dependency (Pfeffer & Salancik et al,) is the EEM exemplified with a stakeholder perspective as a complement to the model and with reference to stakeholder theory (Freeman, 1983, Frooman, 1999, Schmidt, 2000 a o) and theory of legitimacy **Note 4)** These two complements are further described in the so called Malaysian Excellence Model **Note 5)** and will not be further described here.

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A new Empirical Framework

From reviews of pertinent literature of the EEM vs Management Control, we here suggest a new framework for empirical studies of integrated strategy and control system, based on the "European Excellence Model" (EEM). Some elements (A-E)) in this model are described from pertinent theory (theory of TGF and RBV, respectively from Management Control literature; see below: Discussion and Conclusion) The decision process analysis (with reference to PDCA) which are integrated into the model is related to empirical studies of product development processes in a global company **Note 8)**
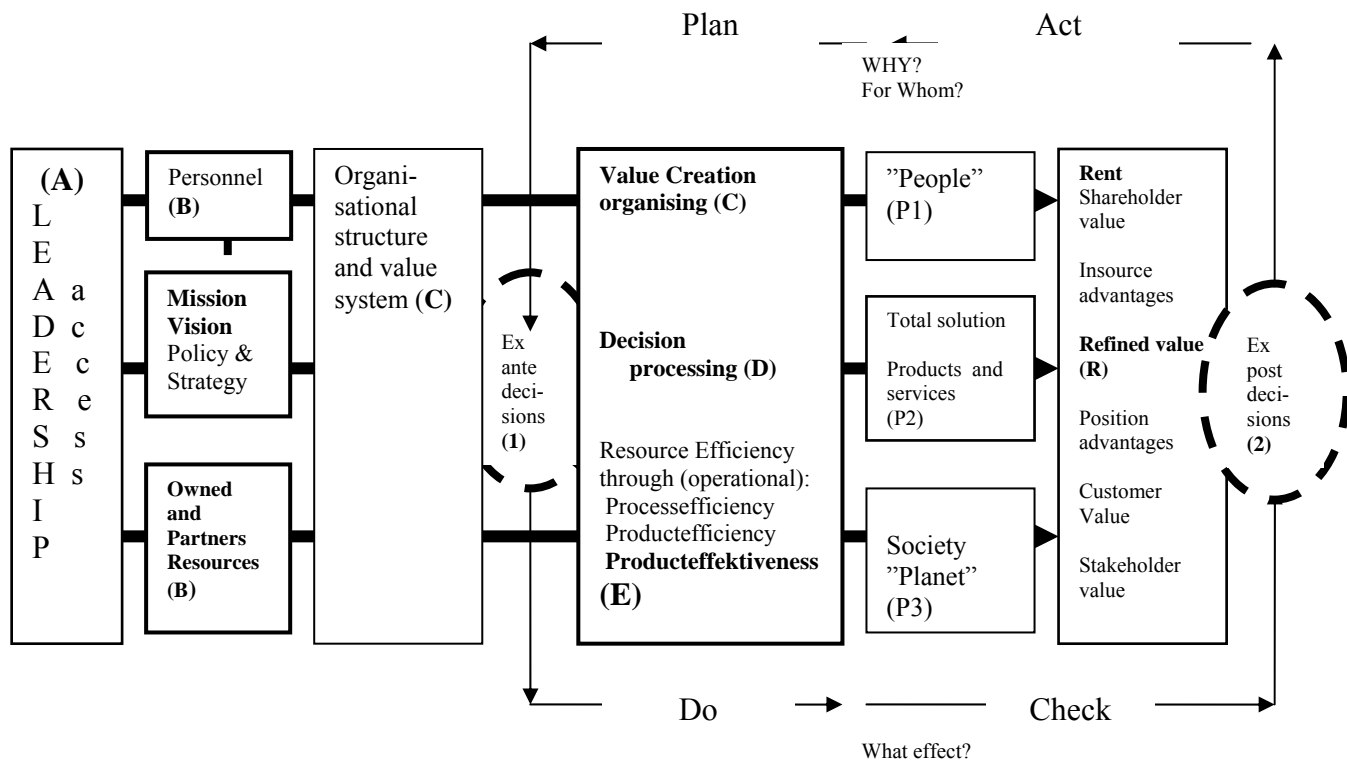

Fig.2 Revised EEM as an integrated research model for Resource-based Strategy and Management Control with a focus on R&D (Input control and Process control, Ex ante 1) and (Output and Result control, Ex post 2)

DISCUSSION AND CONCLUSIONS

There is a need for a new, non-descriptive framework that can visualize how an integrated resource-based strategy and control is related to various parts of company performance. The EEM model visualizes different enablers, organisational-, decisionmaking- and operational processes and various stakeholder results. And this "revised" EEM model also integrates control aspects in two more or less time-related aspects; *ex ante* (diagnostic use) and *ex post* (interactive use) implementation.

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The focus in control (by PMS) is on continuous assessment, both *ex ante* and *ex post.* In order to evaluate the impact of resources (and capabilities) from implementation of a certain business (innovation) strategy in those various parts of the model (a-e) and *to measure it*, especially on the (*ex post)* effects/results, it is necessary to put into operation certain *systemic factors* (such as resources) in order to use the model.

The EEM-model is non-descriptive and may only be used as visualizing areas for further, both theoretical and empirical studies. It therefore seems to be a potential framework for those studies where new theories will be tested and validated with empiri, but only if those systemic factors are operationalised. The EEM-model, or part of it, can then be used as a general framework; independent of contextual dependencies.

In trying to explore the impact on resource based strategy *from* control, five (six) main things (systemic factors or "enablers") in the model have to be considered; (X1)
Ex ante; Management access (to trends etc)
Ex ante; goals and other settings (including environmental)
Ex ante; (PMS) calculations and budgets (diagnostic control), "scorecards"
Ex ante; organizational skills and preferences, responsibilities
Ex ante; most important resources (and other capabilities) and their interdependencies
(Ex ante; processes; especially decision processes and efficiency rates, strategic value creation processes)

In trying to explore the impact from resource based strategies *on* control, seven main things (value creation and result aspects, have to be considered (X2)
Ex post; organizational (management) changes
Ex post; informal processes (including "tacit" dimension)
Ex post; decision process (and unknown changes)
Ex post; (PMS) Refined value, TBL, "Rents"; resource efficiency (interactive control)
Ex post; supplier skills; business obligations
Ex post; innovation/production strategies
Ex post; stakeholder preferences (people, society, customers and partners etc)

Evaluation of EEM as used in self-assessment

As a final conclusion we also discuss the revised EEM as a potential model for use in self assessment **(c)**

The EEM model (and the various parts of it) may be used as a "chart" when performing a critical assessment in various process analysis; especially when conducting self assessment with a reversed process analysis. **Se note 7 and 8**

Note 1) The Malcolm Baldridge Model (1988) was the basisw for the framework for US Quality Award. EEM was established in 1992

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Note 2) Referring to the theories and context of the "triple bottom line" TBL of Elkington, 2000. "the three P´s (People, Profit and Planet")

Note 3) The Dimensions in this, with reference to the EEM are; The Bureaucratic and Mechanic Control approach, The Cybernetic view of Control; The Agency view of Control; The Human Resource view of Control; The Contingency view of Control and The Cultural view of Control In this study the "enablers" in EEM are viewed in those six dimensions

Note 4) Legitimacy as analysing concept (Boström P S., 2005, working paper

Note 5) Integrating resource-based view and stakeholder theory in developing the Malaysian excellence model: a conceptual framework. (Article in *The free library*)

Note 6) For further theory of Resource Based Approach; see also Boström; P S Licentiate thesis (draft) 2008

Note 7) See Conti: Self Assessment: XXX

Note 8) See: Critical Assessment of Process Analysis in R&D (Boström, P S., 2005, working paper)

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In search of well established models and definitions
for process management

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Abstract

Purpose: Process management has been around for a long time, but unlike that of many other management trends, the interest in process management has remained high. There is an ongoing discussion among both practitioners and scholars about how to best manage the value creating flows of activities that run through all organizations.

Numerous process definitions have been proposed, most of them fairly similar. Further, there are well established tools, such as process mapping and measurement, to be applied on individual processes. However, when it comes to managing processes on a strategic system level, process management, the notions and definitions used varies widely.

A starting point for this paper is the idea that the lack of well established conceptual models of process management has a role in the difficulties facing organizations when trying to control their processes on a strategic level. A question is whether there really are some existing widespread and common models and definitions for process management in the literature?

Methodology: A structured literature review is used to identify contemporary models and definitions for process management.

Findings: There are several descriptions and definitions of process management presented in the literature, but none that seems to be really widespread and well established. There are similar components in the definitions of the concept of process the included literature which can be condensed into a net process definition.

The result and analysis of the definitions of process management in the included literature shows two different movements, (A) process management for single process improvement and (B) process management for system management.

The varying purposes of working with process management demonstrate a diverse need for both movements. Still, the focus of a majority of the identified tools and approaches for process management is to contribute to the more mechanistic movement (A) of systematically improving single processes.

There is a strong need for process management practitioners and researcher to develop and formulate approaches and tools that have the potential to contribute to process management not only on a single process level but on a strategic system level in the organization.

Value of paper: The paper provides a literature review and an aggregated description of existing models for process management. It also discusses the implications of the findings on process management in organizations and suggests further research.

Keywords: Process management, models, definitions, literature review.

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Introduction

Process management has been around for a long time, but unlike that of many other management trends, the interest in process management has remained high (Hellström, 2006). There is an ongoing discussion among both practitioners and scholars about how to best manage the value creating flows of activities that run through all organizations.

Numerous process definitions have been proposed through the years, most of them fairly similar. Still, there many disparate views among practitioners regarding the concept of process (Armistead, Pritchard, & Machin, 1999), (Belmiro, Gardiner, Simmons, & Rentes, 2000) and (Isaksson, 2006). Further, when it comes to managing the processes on a system level, process management, the notions and definitions used varies widely (Garvin, 1995), (Armistead & Machin, 1997), (Pritchard & Armistead, 1999), (Ljungberg, 2002), (Biazzo & Bernardi, 2003) and (Hellström & Eriksson, 2007). In addition, the tools and approaches suggested for process management varies both in the literature and in practice and give few clear-cut directions on how to deploy process management (Hellström & Eriksson, 2007).

In parallel, many organizational quality practitioners seem to have grown frustrated about the senior managers' lack of attention on process management. On the other hand, many senior managers still appear to be quite confused regarding why and how to use process management on a strategic, system level.

The starting point for this paper is the idea that the lack of well established conceptual models and definitions of process management has a role in the challenge and difficulty facing organizations when trying to manage their processes on a strategic level. A question is whether there really are some existing widespread and common models and definitions for process management in the literature?

Method

A structured literature review is used to identify contemporary models and definitions for process management. The phrase "Process management" is commonly used in several fields of research (Armistead, Pritchard, & Machin, 1999). Searching all fields on any combination of the phrase made 2747 hits on Emerald, 2099 on EBSCO and 2276 in Compendex. Based on the number of hits and on convenience Emerald was chosen as the source for the further literature search.

Figure 1 – The number of articles included in the study during different phases.

The search was narrowed down to the *exact phrase* of *process management* in *keywords* or *title*. This resulted in 223 hits which were sorted on *relevance* and the work of reading titles and abstracts began. Of the first 50 articles 27 were found to be out of scope. A follow-up analysis was performed which showed that these articles covered manufacturing and production (13), IT/computer science (4) and in the area of interest for the review, but not in

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scope for the purpose of the study (10). Of the next 173 articles 36 were found to be the most relevant, see Table I.

Articles sorted on relevance	Article 1 to 50	Article 51 to 223	Total no. of articles
Interesting for further review	23	36	59
Out of scope, of which:	27	137	164
Manufacturing & production	*13*		
IT /computer science	*4*		
Right field, but out of scope	*10*		

Table I – Number of articles found in Emerald on exact phrase process management in title and keyword, sorted on relevance.

The studied articles have been published fairly evenly over the period 1993-2007, see Diagram 1. This is in line with (Hellström, 2006) who concludes that the number of published articles on process management in the management journals has been fairly constant since the 1980's.
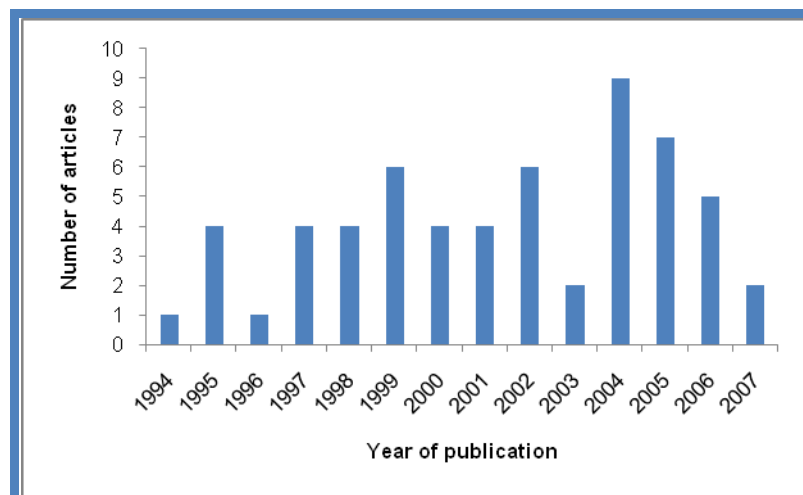
Diagram 1 - Distribution of articles over time in selection after reading title and abstract.

After reading the full articles the selection was narrowed down to 41 items. Additional articles were also identified through references during the reading. In total the review covers 77 full articles, see research report (Palmberg, 2008) and Figure 1.

In order to enable a structure for categorization of the found material four areas of interest were selected based on the purpose of the review:

- Process definitions
- Categorizations of processes
- Definitions of process management
- Approaches and tools within process management

The text was marked and named with headlines. All quotes were gathered in a research report, using the areas of interest as headlines; see (Palmberg, 2008).

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The analysis has been based on the assembled marks from the articles. When approaching the identified areas of interest a list of second level labels, hypothesis to be analyzed, was iteratively developed, containing questions and areas for analysis such as:

- *Area of interest:* Process definitions

- *Second level labels:* Input and output, Purpose, Interrelated activities, Cross-functional Repeatability and Use of Resources.

In the area of definitions of process management the RADAR logic from the EFQM excellence model (EFQM, 2003) was used as an inspiration to categorize the material:

- *Area of interest:* Definitions of process management

- *Second level labels:* What is process management? What is the purpose, the result (R) to be achieved by using process management? What are the approaches (A) within process management? How process management is deployed (D)?

The hypotheses were based on a pre-understanding of both the literature and experience from working with processes management in organizations.

Results and analysis

The material in the research report was further analyzed and formulated into the following sections.

Process definitions

Almost all of the studied authors define "process" in their own words. There seems to be no single definition standing out to be the most broadly spread or most widely used. The differences found between the identified definitions have been reduced to six components that can be seen in a majority of the definitions:

- **Input and output** – Articles that, except the early ones from (Davenport & Short, 1990) and (Harrington, 1991), describe the concept of an input that initiates the process and an output which is the result of the process.

- **Purpose or value for customer** – Having a process external perspective, including a wider purpose of the process – i.e. to meet needs of customers, stakeholders or other interested parties. This is mentioned in several articles, such as (Davenport & Short, 1990), (Harrington, 1991), (Hammer & Champy, 1993), (Talwar, 1993), (Jacobson, 1995), (Belmiro, Gardiner, Simmons, & Rentes, 2000), (Ljungberg, 2002)and (Isaksson, 2006).

- **Interrelated activities** – A majority of the authors describe the components of the process as interrelated activities; (Harrington, 1991), (Hammer & Champy, 1993), (Talwar, 1993), (Rentzhog, 1996), (Armistead & Machin, 1997), (Llewellyn & Armistead, 2000), (Ljungberg, 2002) and (Isaksson, 2006).

- **Horizontal: intra-functional or cross-functional** – (Sandhu & Gunasekaran, 2004) are the only authors found that define a process as a series of activities that "involves an independent functional unit". A dominating view seems to be that processes are horizontal and cross-functional, see for instance (Jacobson, 1995), (Armistead & Machin, 1997), (Lee & Dale, 1998) and (Llewellyn & Armistead, 2000).

- **Repeatability** – Mentioned by a few Swedish authors; (Rentzhog, 1996), (Ljungberg, 2002) and (Isaksson, 2006).

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- **The use of resources** – Mentioned by a few authors; (Biazzo & Bernardi, 2003) and (Isaksson, 2006), include the use of resources in their definitions.

A gross process definition should, based on the included articles, include all the components above, see Figure 2. A net process definition can be condensed to: A horizontal sequence of activities that transforms an input (need) to an output (result) aligned with the organization's objectives, see Figure 3.
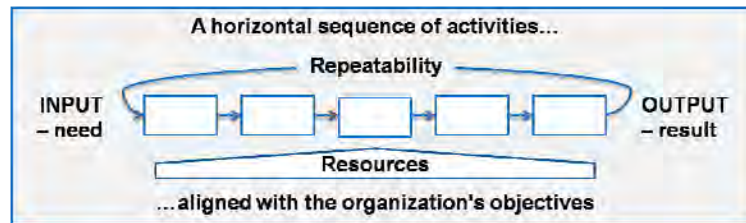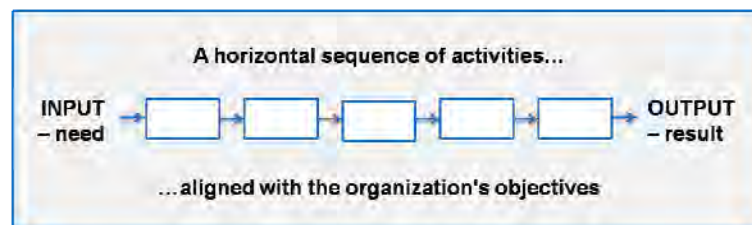

Figure 2 – A gross process definition, including the components; Input and output, Purpose, Interrelated activities, Horizontal Repeatability and Use of Resources.

Figure 3 – A net process definition: A horizontal sequence of activities that transforms an input (need) to an output (result) aligned with the organization's objectives. Excluding the components of Repeatability and Use of Resources, only mentioned by a few authors.

Process categorizations

In the reviewed articles both categories of processes and hierarchies within processes are described, see Figure 4.

Categories – The analysis of the reviewed articles has identified three general process categories, see also (Davenport, 1993), (Jones, 1994), (DeToro & McCabe, 1997), (Llewellyn & Armistead, 2000), (Sandhu & Gunasekaran, 2004) and (Isaksson, 2006).

- **Strategic management processes** – covering strategy, planning and control where management oversees and supervises the system (DeToro & McCabe, 1997), (Armistead, Pritchard, & Machin, 1999), (Chapman, 2001), (Sandhu & Gunasekaran, 2004) and (Isaksson, 2006).

- **Operational delivery processes** – produce outputs and results for external stakeholders (Jones, 1994), (DeToro & McCabe, 1997), (Armistead, Pritchard, & Machin, 1999) and (Isaksson, 2006).

- **Supportive administrative processes** – required to sustain and support the delivery processes (Jones, 1994), (Armistead, Pritchard, & Machin, 1999) and (Isaksson, 2006).

Levels/Hierarchies – In a similar way the levels or hierarchy of processes described in the reviewed articles has been summarized into four categories; **process**, **sub process**, **activities** and **tasks**, see also (Harrington, 1991), (Walsh, 1995), (DeToro & McCabe, 1997), (Lillrank & Liukko, 2004).

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The perhaps most deviant categorization of processes is the "quality broom" described by (Lillrank & Liukko, 2004) which divides processes into **standard**, **routine** and **non-routine**. The level of uncertainty is described to be larger in the non-routine processes and is better managed with a quality culture. While standard processes with identical repetition and a low level of uncertainty can be managed with quality systems.
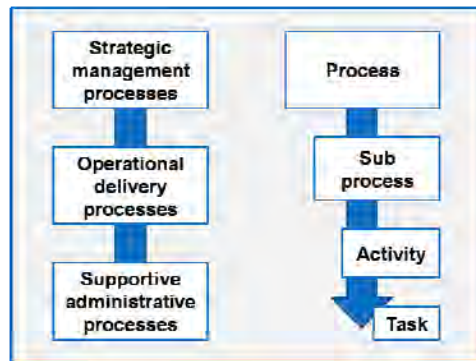

Figure 4 – Two ways to categorize processes.

Definitions of process management

The literature study of definitions of process management gave a large amount of material which was further categorized into a second level of labels.

What is process management?

Very few of the studied authors thoroughly answer this fundamental question. It appears as the answer is implicit but widely agreed upon. Still, there seems to be differences in what the authors consider process management to be. The analysis reveals two distinctly different movements; *process management for single process improvement* and *process management for system management*, see Figure 5.
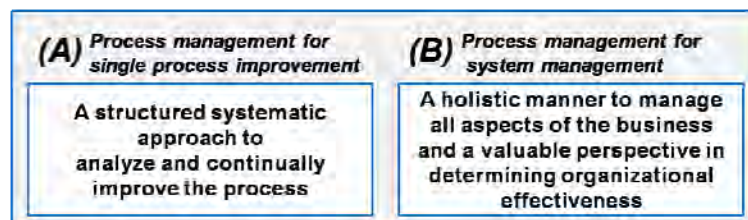

Figure 5 – Two different movements in what the
authors consider process management to be.

The first movement, focusing on the management and improvement of single processes, can be summarized into the statement *(A): A structured systematic approach to analyze and continually improve the process*. This view is shared by (Elzinga, Horak, Chung-Lee, & Bruner, 1995), (Zairi, 1997), (Lee & Dale, 1998) and (Biazzo & Bernardi, 2003).

A holistic view on process management as a part of managing the whole organization is maintained by (Lee & Dale, 1998), (McAdam & McCormack, 2001) and (Bawden & Zuber-Skerritt, 2002). This is described by Pritchard and Armistead (1999, p. 22) as *(B): "a more holistic manner to manage all aspects of the business and as a valuable perspective to adopt in determining organizational effectiveness."*

Lee and Dale (1998, p. 218) somewhat summarize the two views, (A) and (B) above, as: *"BPM is both a set of tools and techniques for improving processes and a method for integrating the whole organization and it needs to be understood by all employees."*

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What is the purpose of process management?
As was the case with the definition of process management there are also differing opinions regarding the purpose of process management:

- To remove barriers between functional groups and bond the organization together (Jones, 1994), (Llewellyn & Armistead, 2000).

- To control and improve the processes of the organization (Melan, 1989), (Pritchard & Armistead, 1999), (Biazzo & Bernardi, 2003) and (Sandhu & Gunasekaran, 2004).

- To improve the quality of products and services (Melan, 1989), (McAdam & McCormack, 2001) and (Sandhu & Gunasekaran, 2004).

- To identify opportunities for outsourcing and the use of technology to support business (Lindsay, Downs, & Lunn, 2003) and (Lock Lee, 2005).

- To improve the quality of collective learning within the organization and between the organization and its environment (Bawden & Zuber-Skerritt, 2002).

- To align the business process with strategic objectives and customer needs (Lee & Dale, 1998).

- To improve organizational effectiveness and improve business performance (Jones, 1994), (Elzinga, Horak, Chung-Lee, & Bruner, 1995) and (Armistead, Pritchard, & Machin, 1999).

It appears to be few major differences in directions or groupings in the reviewed articles regarding the purpose of process management, just a broad variety of arguments for working with it in one way or the other.

Which tools are suggested?
The tools suggested to be used when working with process management are diverse:

- Process mapping (McKay & Radnor, 1998), (McAdam & McCormack, 2001), (Biazzo, 2002) and (Isaksson, 2006).

- Process measurement (Melan, 1992) and (Lockamy III & McCormack, 2004).

- Process re-engineering or re-design (Lee & Dale, 1998), (DeToro & McCabe, 1997) and (McKay & Radnor, 1998).

- Continuous improvement (DeToro & McCabe, 1997) and (Lee & Dale, 1998).

- Benchmarking (DeToro & McCabe, 1997) and (Lee & Dale, 1998).

Which roles are suggested?
The role of the **process owners** is described as:

- Accountable for all process improvement results with authority to approve process changes (DeToro & McCabe, 1997).

- Responsible, through improvements teams, to optimize efficiency and effectiveness, ensuring external customer's requirements are met (DeToro & McCabe, 1997).

- Overseeing performance control and continuous improvement (Biazzo & Bernardi, 2003).

The other role described in the literature is the one of the cross-functional **process team** (DeToro & McCabe, 1997), (Lee & Dale, 1998) and (McAdam & McCormack, 2001). Their

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role is portrayed by (DeToro & McCabe, 1997, p. 58) as: *"to map and document the process, assess performance, analyze deficiencies, select an improvement strategy, propose design changes, implement fixes, and assess results."* The process teams are also described as supporting employee empowerment.

Which are the approaches suggested?

Many authors have combined tools and techniques in to methodologies and checklists that are of a consulting character. How to, step by step, work with process management. The analysis of the material shows a divergence in line with the two different movements, (A) and (B), of what process management is, see Figure 5.

The methodology corresponding to the first definition, (A) process management as a structured systematic approach to analyze and continually improve the process, can be summarized as:

1. **Process selection** – based on analysis of the value chain (Pritchard & Armistead, 1999), identifying customers and suppliers (Sinclair & Zairi, 1995), data collection and process targeting (Armistead, Pritchard, & Machin, 1999) and (Gardner, 2001).

2. **Process description and mapping** – understanding and defining the process (Melan, 1989) and (Harrington, 1995), key activities (Sinclair & Zairi, 1995) and the process architecture (Pritchard & Armistead, 1999) and (Armistead, Pritchard, & Machin, 1999).

3. **Organizing for quality** – establishing ownership of the process, defining and appointing process owners (Melan, 1989), (Harrington, 1995), (Armistead, Pritchard, & Machin, 1999) and (Pritchard & Armistead, 1999).

4. **Process measurements and quantifications** – identifying performance measurements and targets for controlling the process (Melan, 1989), (Jones, 1994), (Harrington, 1995), (Sinclair & Zairi, 1995), (Armistead, Pritchard, & Machin, 1999) and (Pritchard & Armistead, 1999).

5. **Process improvements** – identifying process improvements, e.g. based on measurements and take corrective actions (Melan, 1989), (Jones, 1994), (Harrington, 1995), (Armistead, Pritchard, & Machin, 1999) and (Pritchard & Armistead, 1999), including management of the improvement process and methodology (Jones, 1994).

In line with definition (A) of process management, but with a strong focus on the purpose of identifying opportunities for outsourcing and the use of technology to support business suggested by (Lock Lee, 2005), (Lindsay, Downs, & Lunn, 2003) Lock Lee (2005) presents a methodology that is focused on the design and implementation of software products supporting business processes.

There were hardly any methodologies found that support definition (B) of process management as a more holistic manner to manage all aspects of the business and as a valuable perspective to adopt in determining organizational effectiveness. In (Biazzo & Bernardi, 2003) a methodology is described by four strategic decision-making areas that form, what the authors call, a process management system:

- **Process architecture** – The constitutive component of a PM system where you describe the processes in the organization in a holistic and systematic manner.

- **Process visibility** – Divided into two dimensions; (1) the relationship between the process architecture and the organizational structure and (2) the formalization of the functioning of the processes which gives them operating visibility.

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- **Monitoring mechanisms** – The design of a performance measurement system that will examine and evaluate process performance. With performance indicators that reflects the strategic objectives of the organization.

- **Improvement mechanisms** – The approaches that determine how plans for change will be selected, launched and managed. They should structurally link improvement activities to the daily work and make organizational change systemic and systematic.

The components presented by (Biazzo & Bernardi, 2003) bear a resemblance to the methodologies that supports the definition (A) but with an emphasis on holism and the connection between the work with processes and the strategic objectives of the organization.

Conclusion and discussion

The result and analysis shows, in line with earlier research, that there seems to be no really common definition of the concept of process (Armistead, Pritchard, & Machin, 1999), (Belmiro, Gardiner, Simmons, & Rentes, 2000) and (Isaksson, 2006). Still, there are similar components in the definitions of the included literature. These can be condensed into a net definition, found above in Figure 5 and at the top of Figure 6.

There are several descriptions of process management presented in the literature, but none that seems to be really widespread and well established as a definition. This is in line with what previous research have shown (Garvin, 1995), (Armistead & Machin, 1997), (Pritchard & Armistead, 1999), (Ljungberg, 2002), (Biazzo & Bernardi, 2003) and (Hellström & Eriksson, 2007). Though, the result and analysis of the definitions of process management in the included literature shows two different movements, (A) *process management for single process improvement* and (B) *process management for system management*, see Figure 5 and Figure 6. This is similar to the two models of process management of (Nilsson, 2003) (described in (Hellström, 2006)) described as; (1) a more mechanistic orientation that is characterized by a focus on structural element and (2) an organic orientation that is stronger related to the people in and the flexibility of the process.

The varying purposes of working with process management, described in the covered literature, demonstrate a diverse need for both movements, (A) and (B), of process management. Still, the focus of a majority of the identified tools and approaches for process management is to contribute to the more mechanistic movement (A) of systematically improving single processes. It is a technical and instrumental approach that characterizes the definition of and approach for process management in movement (A).

When it comes to the more holistic movement (B), process management as one of several valuable perspectives in the system management of an organization, hardly any tools and approaches have been found in the literature. Even the identified approaches corresponding to movement (B) can be applied in a linear, mechanistic way – contributing successfully to single process improvements but not as effectively to a strategic and holistic management of the whole organization. This is in correspondence to (Lindsay, Downs, & Lunn, 2003).

The approaches and tools for improving single processes (A) might be mostly suitable for use on an operational level, while the tools and approaches in movement (B) is aiming primarily for the strategic level of an organization. The operational level should be very important for the daily work of process management and improvements throughout the organization, at all levels. As a suggestion, the definition and approaches for movement (B) could be further developed into a model for system management.

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It can de discussed whether or not the shortage of approaches and tools for process management on a strategic level is contributing to the often seen confusion and discontent among senior managers regarding the perceived lack of clear results from implementing process management. The lack of a widely recognized model for process management might be a contributing factor to the challenges and difficulties that meet leaders when trying to manage organizational processes on a strategic, system level. It can be argued that many organizations aim at applying process management of both (A) and (B), using the existing tools and approaches that mainly are developed for (A), but largely expect holistic results on a strategic level.

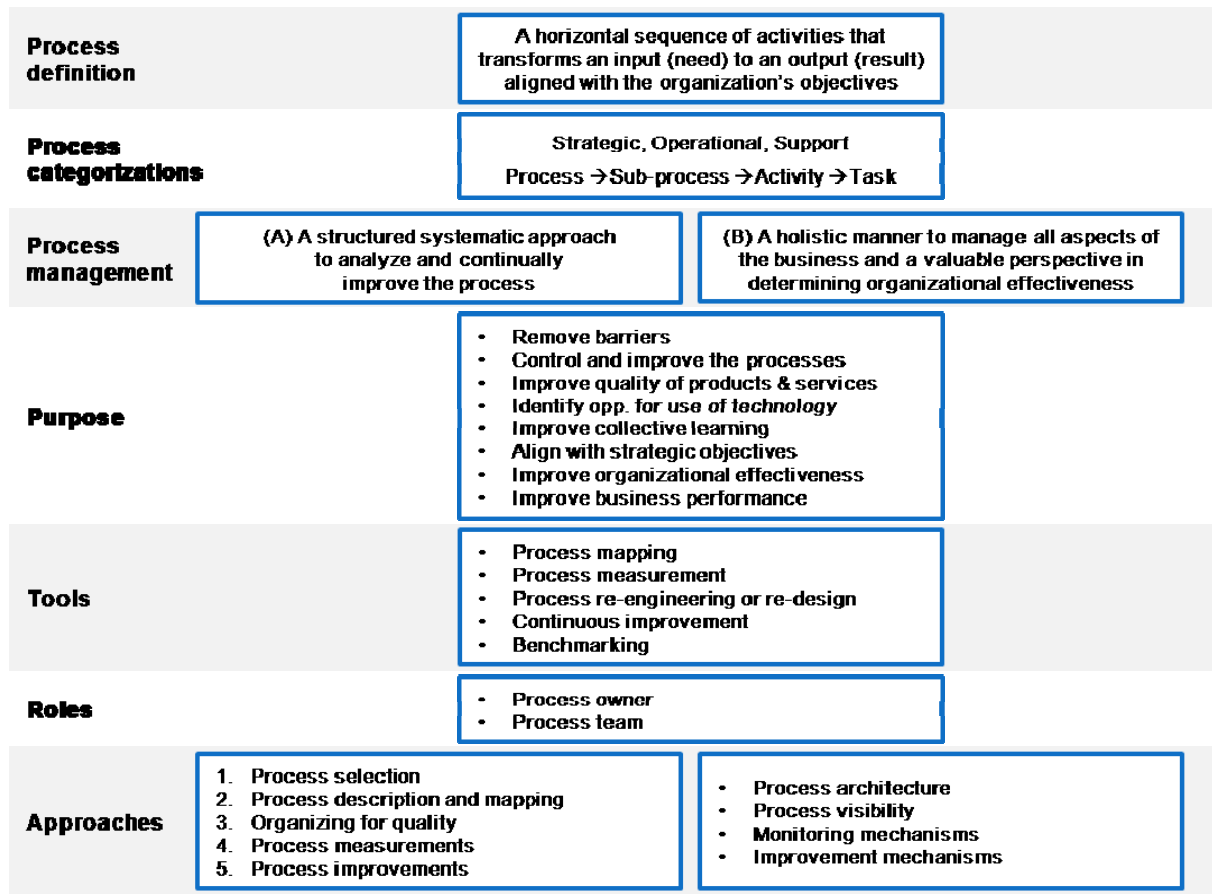| Process definition	A horizontal sequence of activities that transforms an input (need) to an output (result) aligned with the organization's objectives	
Process categorizations	Strategic, Operational, Support Process →Sub-process →Activity →Task	
Process management	(A) A structured systematic approach to analyze and continually improve the process	(B) A holistic manner to manage all aspects of the business and a valuable perspective in determining organizational effectiveness
Purpose	• Remove barriers • Control and improve the processes • Improve quality of products & services • Identify opp. for use of technology • Improve collective learning • Align with strategic objectives • Improve organizational effectiveness • Improve business performance	
Tools	• Process mapping • Process measurement • Process re-engineering or re-design • Continuous improvement • Benchmarking	
Roles	• Process owner • Process team	
Approaches	1. Process selection 2. Process description and mapping 3. Organizing for quality 4. Process measurements 5. Process improvements	• Process architecture • Process visibility • Monitoring mechanisms • Improvement mechanisms

Figure 6 – Summary of the result and analysis of the literature review on definitions of process management.

A wider discussion regarding the interests of practitioners and researchers within the field of process management can be introduced, questioning today's strong focus on the technical and instrumental parts of process management; the definition of a process, the levels and categorizations of processes, and the techniques for mapping and documenting processes on an activity level. Many organizations devote extensive resources to web-based documentation systems, presenting their processes in several levels (lately I have seen up to eight such levels) from main processes down to individual tasks – without having a discussion of how to structurally link the process management work to the strategic objectives and priorities of the organizations. It is hardly surprising that the work with process management does not deliver a more holistic manner to manage all aspects of the business and as a valuable perspective to adopt in determining organizational effectiveness.

There might be a risk in losing the overall business perspective when focusing heavily on maps, tools and checklists aiming for documentation, finding a process structure and

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designing the process organization. A lot of energy in quality functions and process development is aimed at building structures with process owners, process teams and a parallel organization to the traditionally functional organization. It might be important to visualize relationships between the process architecture and the organizational structure and to formalize the functioning of the processes. However, the efforts cannot start here without the *strategic* discussion and making a standpoint on how process management should contribute to the business performance.

There is a strong need for process management practitioners and researcher to develop and formulate approaches and tools that have the potential to contribute to process management not only on a single process level but on a strategic system level in the organization.

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The new method of process quality evaluation

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Abstract

Purpose - The purpose of the research is to develop a model or a method which allows to evaluate a manufacturing process quality on the basis of its many characteristics, i.e. process state measures, occurrences accompanying the process and diagnostic signals.

Methodology/approach – The paper shows the results of a conceptual research concerning the problem of process quality evaluation. The description of the problem, using the terminology of decision sciences, allowed to analyse the multicriteria decision making (MCDM) methods and to choice the apprioprate one.

Findings – It is possible to define the problem of process quality evaluation as the multicriteria decision problem and to apply one of the MCDM methods to its solution. There was indicated that the approach based on decision rules, using rough set theory, is the most applicable tool for the process quality evaluation made in a changeable, dynamic manufacturing environment, also for the sake of the ease of use and results interpretation.

Practical implications – The final aim of the research is to give a process operator a tool to evaluate the process quality online.

Originality/value – The originality of the concept consists in defining the problem of process quality evaluation as a multicriteria decision problem and in pointing out the approach based on decision rules using a rough set theory as the appropriate method of its solution.

Keywords process quality evaluation, multicriteria decision making

Paper type Research paper

1. Introduction

   Factors which decide nowadays about chances of enterprises for surviving on the market are undoubtedly price and punctuality of supplies and quality of manufactured products as well. Making consumers trustful regarding ability of manufacturing products which meet requirements is possible only within the confines of properly functioning production process.

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Thus, the evaluation of a production process state is one of the most important tasks for a process engineer. In this paper evaluation of process state is understood as evaluation of manufacturing process' quality.

With reference to manufacturing processes, quality requirements amount mainly to requirements concerning critical characteristics of a product. For example in manufacturing processes of machine parts these requirements concern dimension and shape accuracy of a product and properties of surface layer.

These characteristics must assure failure-free product used for a period predicted by designer and constructor. One of the means leading to reach this target – but with keeping economical efficiency of manufacturing – is a quality control in the whole product life cycle (Smith, 2002).

Quality control is based on utilizing data arising during widely concerned quality inspection. It consists in active and dynamic (adaptive) controlling manufacturing process runs in all phases of production: product conception, design, technical preparation forproduction, manufacturing, using, service and end of life. Recently an attitude to quality assurance issues has consisted in inspection and controlling activities after completing consecutive stages of production (for example quality inspection made after completing an operation) (Hamrol, 2008).

Today, quality control is carried out in a continuous way, during realization of production process already. It has a character of temporary activities, interventions and its purpose is operational assuring of required manufacturing quality. These activities can consist in: changing a tool, correcting a process, tightening some criteria of inspection, etc.

A basic issue conditioning correctness of functioning quality control in an enterprise is a skill of utilizing data generated on various stations in making decisions. In a company proper systems must exist to make correct data flow and its analysis possible. On the basis of this concluding and making decisions can take place.

These decisions can be (Hamrol, 2008):
- operational – made directly on the working station based on data received from a process (their result can be temporary correction of a process),
- tactical – allowing intervention into the quality of a manufactured product at the stage of planning and preparing for production – made by managers (systematic impact on quality of performance),
- strategic – oriented on realization of enterprise's targets defined as strategic (creating new products, reaching new markets, making technology more modern, employing specialists) – they involve predicting and planning of undertakings which from the perspective of quality system consist in interference in quality of design.

Generally, these decisions can be made basing on information gathered from (Hamrol, 2000):
- direct measurement of machined parts – measurement is carried out after completing an operation,
- from measurement of signals coming from phenomena accompanying the process (e.g. signal of force, temperature, vibrations) – measurement is made online,
- from observation of occurrences taking place during realization of a process (error of process operator, machine breakdown) – observed.

Information from measurement of machined parts is gathered as a result of 100 percent inspection, acceptance sampling and statistical process control.

Despite having advanced measurement technique and applying more and more user-friendly and advanced software to process results of quality inspection, the realizion of efficient information feedback between manufacturing process and remaining elements of the system is still a serious problem.

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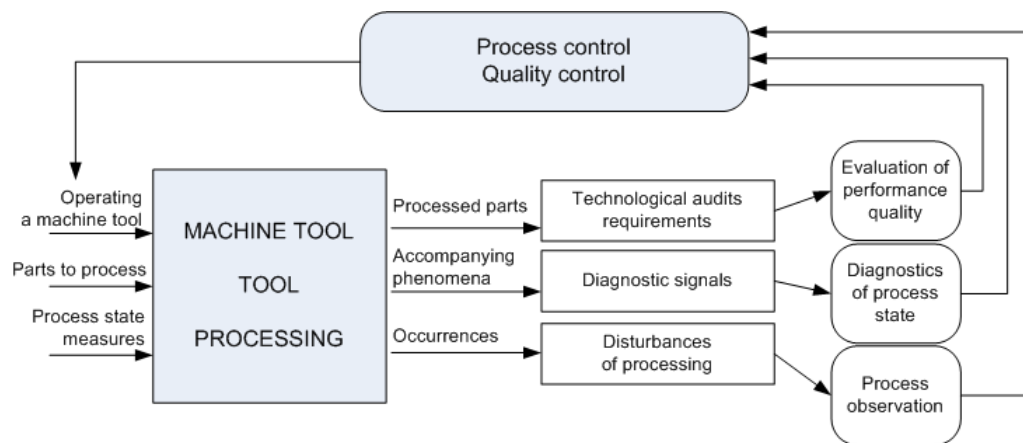Excellence; 20-22 August; 2008 in Helsingborg; Sweden

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Fig. 1. Data sources for activities connected with quality control

In many cases data gathered from production in progress is wasted – it is used only for temporary regulation of a process, is often gathered only to fulfill consumers' requirements concerning so called quality records. Traditional tools of quality management often show many weaknesses. For example control charts and capability indices do not transfer information about causes of process disturbances and hints concerning a corrective action. It causes that potential possibilities of statistical process control are not exploited. In literature of this subject there is a lack of information which would indicate a solution making it possible to use diagnostic information and data about occurrences in the evaluation of a process.

Hence, there is a need to make some work in order to eliminate or at least limit these weaknesses and use wisely gathered information about a process (measurements, diagnostic signals and occurrences) in making decisions about the process state.

2. Problem

Data and information gathered from a process can concern parameters of machine set-up, process state measures, values of specified product characteristics or statistics (mean, standard deviation etc.), capability indices' values, set of information concerning causes of process maladjustment (e.g. dressing of cutting edge, wear land, mistake in service, etc.) and corrective actions taken (replacing a tool, correcting adjustment, changing the depth of a cut, etc.).

The main problem in evaluation of process state is finding a model or method which would allow to make this evaluation taking into account many characteristics (e.g. diagnostic data, critical characteristics' values, occurrences in process). From this point of view process state evaluation becomes a problem of making decision taking into account many criteria.

Using methods from Multicriteria Decision Making (MCDM) area which let a process state be qualified to predefined classes seems justifiable.

3. Multicriteria decision making – the main characteristics

Multicriteria decision making (MCDM) is a scientific discipline whose aim is to make a decision maker equipped with tools enabling him to solve problems considering many, sometimes opposing, points of view. Multicriteria decision problem (MDP) is a situation in which, having defined a set of actions (solutions, objects, decisions, variants, candidates) and a family of criteria, decision maker aims to either choice the best action (choice problem) or sort the actions to the predefined classes (classification problem), or rank the actions from the best to the worst (ranking problem). A decision maker (DM) who solves multicriteria

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decision problem is expected to compare many actions with different values of separate criteria. A classic idea of optimization does not have an application in this case because it is not possible to find optimal solutions, i.e. the best ones from all points of view. To find the final recommendation (solution) it is necessary to build and then exploit the preference model (criteria aggregation model) of a decision maker (Vincke, 1994).

There are three ways of representing of the preference information:

- function (e.g. additive utility function),
- relational system (e.g. relation of outranking),
- set of decision rules (Greco *et al.*, 2004; Słowiński 2007).

Multicriteria decision problems are solved in 4 steps:

1. Specifying actions and type of issue (choice, classification and ranking).
2. Constructing consistent family of criteria and modeling decision maker's preferences.
3. Synthesis of decision maker's preferences model:
   - to one criterion (model in the form of function),
   - to relational system,
   - to system of rules.
4. Exploitation of decision maker's preferences model in the confines of proper issue.

MCDM as a scientific discipline worked out many methods to solve multicriteria decision problems. The most general classification accepted by many experts distinguishes the following groups of multicriteria decision aiding methods (Vincke, 1994):

- methods of multi-attribute utility theory – named also as "methods of synthesis to single criterion" – they do not take into account incomparability of variants. The most well-known methods from this group are AHP (Saaty, 1980) and UTA (Jacquet-Lagreze & Siskos, 1982)
- methods based on outranking relation – named as methods of outranking synthesis where incomparability is accepted. The most well-known methods from this group are methods from ELECTRE family (I-IV) (Benayoun, *et al.*, 1966).
- interactive methods + named as methods of local dialogue assessment based on trial-and-error attitude in consecutive iterations, e.g. LBS. (Jaszkiewicz & Słowiński, 1995).

In the recent years the approach basing on the decision rules joined these groups (Greco, *et al.*, 2004; Słowiński, 2007).

4. The evaluation of the manufacturing process state as multicriteria decision problem

As mentioned above, the task of evaluation of the manufacturing process state can be considered as a multicriteria decision problem. In the present chapter there was placed the description of the investigated research problem using the terminology of decision sciences.

The task of the evaluation of the manufacturing process state, formulating it in the most general way, can be defined as follows: in order to estimate the quality of items being currently manufactured the evaluation of the manufacturing process state should be determined on the basis of many characteristics of the process (state measures, occurrences and diagnostic signals), in other words determining the probability of obtaining a product of a given quality class .

The decisive variant here is obtainable in real conditions realization of the manufacturing process, i.e. the vector *a* of concrete values of process state measures (M), occurrences (O) and diagnostic signals (S) representing the manufacturing process state, $a = [M_1,M_2,...M_x,O_1,O_2,...O_y,S_1,S_2,...S_z]$, where *x* means the number of considered state measures, *y* the number of occurrences and *z* the number of considered diagnostic signals. The criteria of evaluation of the concrete realization of the process are process state measures, occurrences and diagnostic signals (M, O, S). The preference information is data

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concerning earlier realization of the process (i.e. the evaluation of quality of parts or products manufactured in a certain process state described by a certain vector *a*). The task is shown schematically in the table No. I.

The particular actions (here process realizations) are represented by the rows of the table – the vector $a_i = [M_{i1},M_{i2},...M_{ix},O_{i1},O_{i2},...O_{iy},S_{i1},S_{i2},...S_{iz}]$, where $i=1,2,...,m$ means the i-th action (the i-th process realization). Having in mind that M, O and S are criteria, whereas $x+y+z=n$, the following notation for a_i is also possible $a_i = [c_{i1},c_{i2},...,c_{ix},c_{i(x+1)},...,c_{i(x+y)},c_{i(x+y+1)},...,c_{i(x+y+z)}]$, where $i=1,2,...,m$ means the i-th action.

In the columns of the table the values of a given criterion for each individual action are contained (columns 1-n), while the 2 last columns represent the solution of the decision problem in the symbolic form of an hypothetical assignment to the predefined classes (column n+1) or in the form of additive utility function (column n+2).

Table I. The task of the evaluation of the manufacturing process state (process quality) as a MDP

	Criterion 1 c_1 (state measure 1)	Criterion 2 c_2 (state measure 2)	...	Criterion x c_x (state measure x)	Criterion x+1 c_{x+1} (occurrence 1)	...	Criterion x+y c_{x+y} (occurrence y)	Criterion x+y+1 c_{x+y+1} (signal 1)	...	Criterion n c_n (signal z) where n=x+y+z	ASSIGNMENT TO ONE OF QUALITY CLASSES (e.g. 1,2,3)	QUALITY quality evaluation (function of criteria)
Action 1 a_1 process realization 1			...			...			...		Class 1	Quality of action 1 $Q_1=\sum f_i(c_{1i})$
Action 2 a_2 process realization 2			...			...			...		Class 1	Quality of action 2 $Q_2=\sum f_i(c_{2i})$
...	...	...						...	...			...
Action m a_m process realization m			...			...			...		Class 2	Quality of action m $Q_m=\sum f_i(c_{mi})$

This task, according to the authors, should be solved in two steps. In the first step the evaluation of the manufacturing process state would be done, done through the estimation of partial quality of manufactured items (taking into account only one characteristic of the part – e.g. roughness) on the basis of process state measures, occurrences and diagnostic signals occuring during the manufacturing process. In other words the probability of obtaining, as a result of the manufacturing process being in a certain state, parts that meet quality requirement (i.e. requirement relating to one characteristic) is determined (let us call this step the subtask 1). This step should be executed for each characrteristic that is taken into consideration (in case of machining there could be for instance roughness, waviness, rectilinearity, hardness, bending strength, etc.)

Next, the global evaluation of the quality of the part (global evaluation of the process state) should be determined on the basis of its partial quality evaluations, i.e. either measurements of each individual characteristic of the manufactured part and/or their evaluation took by an expert, or on the basis of the received as the result of subtask 1 probabilities of obtaining parts that fulfil each quality requirement (in the form of assigning to the class or aggregated numerical value). Let us call step 2 the subtask 2.

Formulating it generally, in the task of evaluation of the manufacturing process state that is conducted in order to estimate the probability of obtaining parts fulfilling quality requirements, two stages can be distinguished: the stage of determining partial evaluation of quality on the basis of diagnostic data of the manufacturing process (subtask 1) and the stage

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of obtaining the global evaluation of part quality (the evaluation of the manufacturing process state and connected with them probability of obtaining parts that meet all quality requirements) on the basis on partial evaluations of the quality received in the previous stage (subtask 2).

Both subtasks should be considered as separate decision problems. The subtask 1 that consists in the obtaining of partial evaluation of quality of the manufactured part on the basis of process state measures, occurrences and diagnostic signals belongs to the group of sorting problem (classification), i.e. its solution consists in assigning of each action to one of the predefined classes, in this case the quality classes of the item (e.g. very good, good, poor). But in the particular case the desicion maker (here e.g. machine operator) could care about something more than „only" the assigning of the manufactured part to the quality class, namely about the obtaining of the precisely numerical evaluation of the manufactured part. If the problem is stated in such a way, the methods dedicated for a multicriteria ranking or choice (e.g. UTA) should be used. These methods base on additive value function, i.e. aggregate the partial evaluation on each criterion to one global evaluation of a given action so the resulted evaluation has a numerical form.

In the subtask 1 occur the same actions and criteria as in the main research problem (original task) desribed earlier. The preference information make up the data concerning the earlier process realization but as opposed to the original task there are evaluations of the partial (not global) quality (e.g. regarding roughness) of the parts that were manufactured in a specific process state described by certain vectors a.
The subtask 1 was schematically illustrated in the table no. II.

The interpretation of the rows and columns of the table is the same as in the case of original task, with the difference in 2 last columns. They represent here the solution of the subtask 1, i.e. the hypothetical assignment to the predefined classes of partial quality (column n+1) and the additive utility fuction (column n+2) determined for partial quality.

Table II. The subtask of partial evaluation (focused on one characteristic of the product) of the manufacturing process state as a MDP

	Criterion 1 c_1 (state measure 1)	Criterion 2 c_2 (state measure 2)	...	Criterion x c_x (state measure x)	Criterion x+1 c_{x+1} (occurrence 1)	...	Criterion x+y c_{x+y} (occurence y)	Criterion x+y+1 c_{x+y+1} (signal 1)	...	Criterion n c_n (signal z) where n=x+y+z	ASSIGNMENT TO ONE OF PARTIAL QUALITY CLASSES (e.g. 1,2,3)	PARTIAL QUALITY partial quality evaluation (e.g. „quality = roughness")
Action 1 a_1 process realization 1			...			...			...		Class 1	Partial quality of action 1 $Qp_1=\sum f_i(c_{1i})$
Action 2 a_2 process realization 2			...			...			...		Class 1	Partial quality of action 2 $Qp_2=\sum f_i(c_{2i})$
...	...	...	...		...			...	...			...
Action m a_m process realization m			...			...			...		Class 2	Partial quality of action m $Qp_m=\sum f_i(c_{mi})$

In the subtask 2 which consists in determining the global evaluation of the quality (the whole evaluation of the process state) on the basis of the values of partial qualities the evaluation criteria are values of those parts' characteristics ($c_1, c_2, ... c_n$) that are taken into consideration during the evaluation of the part's quality (e.g. roughness, waviness, rectilinearity, hardness, bending strength, etc.) or partial quality evaluations determined for

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the sake of those particular characteristics. Speaking about the action (decision action) the authors mean in this case the possibility to obtain in reality vector of „quality"characteristics of an item (combination of partial quality evaluation of a part), a = $[c_1, c_2, ... c_n]$. The preference information given by the decision maker is a global quality evaluation of a product specified for each part from a certain reference group, that is the evaluation of the chosen actions (here items) building the so called reference action set. The subtask 2, like a subtask 1 is a classification problem, however in order to obtain the precisely numerical evaluation of the quality of manufactured parts, obtained as a result of the running process, the approach that aggregates the evaluations to the one utility function should be applied.

The table III exemplifies the above characteristics of subtask 2.

Table III. The subtask of the evaluation of global quality of the product on the basis on its partial qualities as a MDP

	Criterion 1 c_1 (roughness)	Criterion 2 c_2 (endurance)	...	Criterion n c_n (hardness)	ASSIGNMENT TO ONE OF QUALITY CLASSES (e.g. 1,2,3)	GLOBAL QUALITY global quality evaluation (function of partial quality evaluations)
Action 1 a_1 (part 1)			...		Class 1	Quality of action 1 $Q_1 = \sum f_i (c_{1i})$
Action 2 a_2 (part 2)			...		Class 3	Quality of action 2 $Q_2 = \sum f_i (c_{2i})$
...	...	...	...	...		...
Action a_m (part m)			...		Class 3	Quality of action m $Q_m = \sum f_i (c_{mi})$

The rows of the table represent the particular actions (here manufactured parts) in the form of a vector $a_1 = (c_{i1}, c_{i2}...c_{in})$, where i=1,2,...,m mean an i-th action. The columns of the table contain values of the given criteria for each individual actions (columns 1-n), while 2 last colums represent the solution of decision problem in the symbolic form of an hypothetical assignment to the predefined classes (column n+1) or in the form of additive utility function (column n+2).

5. The choice of the MCDM method

After the research problem has been defined using the concepts of decision sciences, the methods elaborated by decision sciences can be applied. The choice of the method to be implemented in the production environment is influenced by the following factors:
- type of the problem (in this case: classification),
- required type of preference information (e.g. the examples of decisions or the pairwise comparisons of all actions and criteria, or preference, indifference and veto thresholds),
- requirements respecting the necessary knowledge of the decision maker about the used method,
- ease of interpretation and acceptation of the results.

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For this reason the authors regard the decision rules based approach as the best solution of the problem of the evalutation of the manufacturing process state. This approach can be applied to all types of decision problems, but it is especially suitable for classification.

The models using decision rules "if..., then" allow to give the examples of decision as the preference information (Greco *et al*., 2004; Słowiński, 2007) while people are more inclined to show examples of their decisions rather than explain them by giving model parameters.

The understanding by the decision maker (the user of the method - here the machine operator or process engineer) of the way of the exploitation of the preference model aggregated to the set of decision rules does not require a great cognitive effort from him. The mined decision rules can be also easily interpreted or even (in a special case) rejected as incorrect by the decision maker .

Furthermore, Greco, Matarazzo and Słowiński (2004) stated that the decision rule aggregation (preference model) is the most general among the known aggregation operators (preference models).

The generality and resulting from it flexibility of the logic rule approach makes it seemingly the most useful tool in the evaluation of the manufacturing process state which is changeable and described by the characteristics of various nature (e.g. binary, modeled by unlinear function).

6. Decision rules approach using Rough Set Theory

The decision rules are widely used by expert systems to represent the knowledge of an expert. The researchers from the domain of multicriteria decision making developed the approach of decision rules mining using the rough set theory (RST). The concept of rough sets was proposed by Pawlak (1982) and allows to deal with uncertain and vague data which follow from data granulation. The classical definition of a set is replaced by two – lower and upper - approximations of it. The lower approximation of X is composed of elements which certainly belong to X, while the upper approximation consists of elements which may belong to X (i.e. in the light of available knowlegde it is not possible to exlude their belonging to X). The objects having the same description, expressed by means of some attributes, are indiscernible - they are in the indiscernibility relation (Greco, *et al.*, 2001).

Several attemps were made to apply the RST to the decision support (Pawlak & Słowiński, 1994) but it was finally made possible after extension of the classical RST by Greco, Matarazzo and Słowiński consisting in substitution of the indiscernibility relation by a dominance relation in the rough approximation of decision classes to consider the preference order of data). An important consequence of this fact was a possibility of inferring from exemplary decision the preference model in terms of decision rules being logical statements of the type "if..., then" (Greco, *et al.*, 2001).

The approaches based on RST are called in the MCDM literature the Classical Rough Set Approach (CRSA) and the Dominance-based Rough Set Approach (DRSA), respectively. A detailed description of RST and decision support approaches based on it exceedes a framework of this paper and it is to be found in the cited literature.

The authors decided to apply the DRSA approach to the evaluation of the manufacturing process quality. The experimental investigation will be undertaken as the next step of the presented conceptual research on the problem. Initially the DRSA will be applied to the subtask of the evaluation of the global quality of the product on the basis of its partial qualities (illustrated in the table III).

Generally speaking, the procedure of evaluation consisting of the classification of a product to the quality class will include the following steps:
1. gaining of the exemplary decision from an expert (so-called "learning set") in the form: if $c_1(a)=r, c_2(a)=p, ... c_n(a)=q$, then $a \rightarrow$ Class 1

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2. discretization of attributes (criteria) values, if necessary
3. induction of decision rules based on the Dominance-based Rough Set Approach (the method mines three types of rules: certain, possible and approximate rules)
4. verification of the rules by an expert (decision maker)
5. application of the decision rules to new objects (to so-called "testing set").

The presented approach to the multicriteria classification has many advantages described in the above chapter. They are connected with the use of the preference model in the form of decision rules. The preference information in the form of exemplary decisions or ease of results interpretation belong to the most important from the point of view of a method user, who is in this case a machine operator or a process engineer. It is also worth mentioning that RST allows to reduce the initial set of attributes (criteria) and to evaluate their importance, which is particularly useful in the evaluation of the manufacturing process, that can be described by many various attributes.

The CRSA and DRSA approaches are still gaining the followers from various research areas (e.g. management, medicine, engineering). They found their application also in technical diagnostics and quality control (Shen, *et al.*, 2000; Tseng, *et al.*, 2004; Sawicki & Żak, 2007) what is especially interesting and promising from the authors point of view, but are still not widely applied in these domains.

7. Summary

Nowadays the effective quality control of manufacturing has to be based on data coming from two basic sources: quality inspection of manufactured parts and also from measurement and observation of manufacturing process, whereas one of the key issues conditioning the correctness of this process is the ability to use data generated on various stands to make decisions. The data describes manufacturing process which allows to infer about the probability of obtaining, as a result of the running process, parts that meet quality requirements. The authors have classified the task of the evaluation of the process quality to the multicriteria decision problems and proposed its solution using decision rules based on Dominance-based Rought Set Approach. In the selection of the method the authors were guided by the possibility of the solution's application in the manufacturing environment (there was paid the attention on the ease of defining the decision maker preferences and the ease of results „acceptation" in the proposed method). The issue being elaborated is a part of a more comprehensive research project consisting in elaborating „the system of control of production flow and quality for small and medium enterprises".

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Framework of Key Processes and Quality Management

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Abstract

Purpose – Many organizations integrate their performance improvement initiatives under the banner of process management methodologies. This paper resumes the spectrum of the most common Business Process Management, as is currently applied in practice and attempts to contribute to the problem of key business processes' identification.

Design/Methodology/Approach – The paper utilizes quality tools and techniques in the identification of key processes.

Findings – A quality based methodology to key processes' identification is presented.

Research limitations – Many of the detailed and already applied business approaches may have not been made publicly available.

Originality/value - Integration of quality tools and techniques with processes management.

Short biography of the author(s) - Please see the lines below the authors at the paper title area.

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Introduction

Changes in customer behaviour, powerful international competition, increased complexity of Organizational environment and rapid growth of IT systems have forced a lot of companies to realize that their way of operation needs to be changed and adapted to the new requirements. Performance improvement has become a strategic imperative, so that executives and managers are constantly trying to improve their organizations performance by implementing well known programs, such as Total Quality Management, Balanced Scorecard, BPR and Six Sigma. Companies like IBM, Hewlett Packard, Geon, General Mills, Texas Instruments, Owens-Corning, Duke Power have found that although each of these performance initiatives can reinforce business results, they need to be positioned under a process management philosophy if they are to be successfully integrated (Hammer, 2002; Armistead, 1999).

Business Process Management (BPM) is a structured approach to performance improvement that focuses on the disciplined design and careful execution of a company's end-to-end business processes. BPM is an approach dependent on strategic elements, operational elements, use of modern tools and techniques, people involvement and, more importantly, on a horizontal focus which will best suit and deliver customer requirements in an optimum and satisfactory way. Process management draws the attention of executives on the framework of key processes, the outputs of which delivers organizational goals that satisfy stakeholders needs. Process management makes team members to understand how processes relate to other processes within the organization and with their customers. There is a range of tools which help teams to understand a process, many of which have been already used in quality management field.

Many researchers mainly from the management field have provided their insight and writings in process management. Some of them have focused their efforts for conducting research in this filed, most notably process management principles, frameworks, tools and techniques and best practices. However, it seems that key process identification is an interesting area, which requires special attention and research. Accordingly, the objectives of this article are:

- To highlight the main messages and principles that have been developed and applied in practice
- To draw attention to the problem of key business process identification
- To utilize quality tools and techniques for the identification of key processes.

1. Literature Review

For the purpose of achieving the objectives mentioned above, first, a review of Business Process Management relevant literature is presented.

Since the 1990s, some researchers like Hammer, Davenport, Harrington, Garvin, Armistead and Zairi have focused their effort for conducting research in the filed of "process improvement" and many more relative terms. Each of them has made major contributions to Process Management as we know it today. EFQM Business Excellence Model, Malcolm Baldrige National Quality Award (MBNQA), Six Sigma, Balanced Scorecard and the International Quality Management Standard ISO:9001 stress the importance of the concept. The main principles and elements, as they have been developed and applied by the experts and the participated Organizations, follow.

1.1 The issue of process management definition

The attention that is given to the processes via which a company creates its products, services and impacts its operations is one of the important characteristic traits of TQM, BPR, and Six Sigma. Today, the importance that is given in the processes of a company is widely recognized. Nevertheless, it is often accompanied by the uncertainties and the functional

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difficulties of Management approaches. A recent study that has selected a sample of companies that applied the EFQM Excellence program indicated that one of the problems was the implementation of Process Management. In particular, the lack of a sound meaning creates much of the difficulty in defining an organization's business processes (Pritchard and Armistead, 1999). Another empiric research regarding ``Business Process Re - engineering'' reveals that companies often do not have a clear perception of the process management concept (Belmiro et al, 2000). Some definitions of process drawn from recent experts' works follow (Table 1). All of them suggest that a "process" is a set or a group of activities in their conceptual determination of a process.

Table 1. Definition of a process

Hammer (2002)	a group of activities that together create a desired result
Davenport (2005)	the set of activities it pursues to accomplish a particular objective for a particular customer, either internal or external
Harrington (1993)	any activity or group of activities that takes an input, adds value to it, and provides an output to an internal or external customer.
Armistead (1995)	conversion of inputs (resources) into outputs (goods and services)
Garvin (1998)	collections of tasks and activities that together -- and only together -- transform inputs into outputs
Zairi (1997)	an approach for converting inputs into outputs
ISO 9000:2000	a system of activities that uses resources to convert inputs into outputs

In addition to these definitions, the fact is that the word process has different associations across many academic domains including theology, sociology, anthropology, psychology and economics. The resulting ambiguity leads to a lack of shared understanding that causes confusion, frustration and wasted effort (Armistead, 1995, 1999). Armistead suggested that operations management is a useful place to start with in the quest for a definitive answer. This is because operations management is based on the concept of managing the transformation process and "Process" refers to the conversion of inputs (resources) into outputs (goods and services).

Garvin (1998) recommend that processes can be defined as collections of tasks and activities that together transform inputs into outputs. Common examples of processes include new product development, order fulfilment, and customer service; less obvious but equally legitimate candidates are resource allocation and decision-making.

Therefore, it seems that process is a group of activities that are related and organized, and they work together to create a result that add value to a customer or a stakeholder. However, the simplicity and the lack of a standard definition create much of the difficulty in defining further an organization's business processes.

1.2 Process Management principles

Understanding the process may be achieved by the formulation of a new set of common principles that correspond to and are required by the customer-oriented environment. Principles of process management (Hammer 1999, 1990; Armistead 1996, 1999, 2000; Zairi 1997), shown in Table 2, provide perhaps the essential characteristics and a point of reference to encouragement, involvement and effective kick off. For example, Hammer emphasizes on results and outcomes of the tasks, not the tasks themselves. This principle eschews Adam Smith's traditional management notion that efficiency is achieved by decomposing processes into tasks. Process orientation is seen by Hammer, Armistead, Zairi as a way of relating and linking processes within the organization in order to get closer to its customers whilst simultaneously managing and improving the organization itself and its competitiveness.

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Table 2. Process Management principles

Armistead (1996)	Hammer (1990)	Zairi (1997)
1. Designate a process champion. 2. Know the process. 3. Understand the linkages. 4. Work on the trade-offs. 5. Teach others about the process. 6. Train within the process. 7. Measure the process. 8. Manage careers. 9. Build specialist expertise. 10. Improve the process.	1. Organize around results and outcomes, not tasks 2. Have those who use the output of the process perform the process 3. Subsume information-processing work into the real work that produces the information 4. Treat geographically dispersed resources as though they were centralized 5. Link parallel activities instead of integrating their results 6. Put the decision point where the work is performed 7. Capture information once and at the source	1. Mapping and documentation of major activities. 2. Focus on customers through horizontal linkages between key activities. 3. Systems support and procedures documentation. 4. Performance measurement and assessment of key activities 5. Continuous improvement 6. Culture change through good systems and right structure.

Their ideas are based on systems thinking analysis in the sense that it can provide a description of the components, their relationship and their interaction with all other components as well as the environment (Senge, 1990; Rummler and Brache, 1995). Identification of processes is a key principle towards being able to manage processes (Hammer, Zairi). This varies from identification of a small number of core business processes to attempting to identify all organizational processes. The importance of standardizing and documenting processes in order to deal with many contingencies is highlighted by Hammer, Zairi and Davenport.

Armistead and Zairi emphasize also the regular measurement, the learning and the continuous improvement of processes as a central part of the process initiative and the designation for a process owner or champion who will have responsibility for the whole process. Process teams have to be assigned to improve and in some cases manage the processes. Quality tools will be needed according to Armistead for helping teams towards process orientation and management.

These principles which are based on systems thinking can be used for making clearer the meaning of *process* as it is used in 'business process management' and many more relative terms. These principles should deal with the:

- Results that a company deliver to its customers to satisfy their needs and expectations.
- Identification of key process that deliver determined business results
- Standardization and documentation of key processes
- Regular measurement, learning and continuous improvement of processes.
- Assignments of process owner and process teams that will work the defined principles with the support of Quality and Management tools.

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1.3 Strategic direction and results

One of the key principles and problems so far with process-oriented attempts at organizational change is the lack of connection to strategic results (Harrington, 1995; Hammer, 1990; 2001; Armistead C., Pritchard J.P., Machin S., 1999). This is due to the fact that 'Business process', 'Business process improvement', 'Continuous process improvement', 'Business process reengineering' and many more process-orientation attempts still seems to be approached in a mainly functional way (Hammer, 1990; Kaplan and Murdock, 1991; Garvin, 1995; Rummler and Brache, 1995;). In fact, Rummler and Brache (1995) rank the lack of connection to strategy as the number one problem with process orientation. Similarly, in another study, which describes the experience of North American and European organizations with Business Process Reengineering (BPM), an important conclusion was that BPM is not enough on its own. It has to be linked to strategic direction and results (The Economist, 1994).

The true potential of process orientation may not be realized unless combined is process orientation with systems thinking, as it was mentioned in the previous section. Adopting this point of view requires that processes produce a result that the customer desires, as well as trying to produce this result in the most optimal way. The focus is, in other words, both on effectiveness and efficiency. Without an understanding of the big picture and how the details fit and relate into the big picture, it is difficult for companies to prioritize and choose between potential opportunities. Thus, strategy and goals should provide direction for business processes and also direction for efforts to improve. Companies need to work with these strategic aspects. They need to develop a future vision. They also need to translate this vision into concrete strategy and goals in order to guide the process orientation effort. At this point, another important part is to prioritize elements that are of importance and elements that are of less importance. With a clear strategic choice and direction not all processes are equally important, not all processes are as interesting, and not all measurements are as relevant. Prioritizing can, in turn, save organizations time and resources.

1.4 Process orientation

Process orientation includes structural aspects such as classifying processes and defining the most important processes. These structural aspects in the context of Business Process Management are not an easy work to deal with and resolve (Armistead C., Pritchard J.P., Machin S. 1999). Findings of the authors suggest that processes may remain as a list of several sub-processes, or they may be refined and drawn into a process map with some identification of core or support processes.

In the literature there seems to be a number of competing views upon the kind and the number of processes needed to fulfil the aim of an organization. Harrington (1995, 1996, 2000) focuses on the organization's processes and the output that its customers receive. These processes are part of three building blocks, which are: Process breakthrough which refers to the critical business processes (overhead-type activities), Product process excellence that refers to product design activities and production process and Service process excellence that focuses on how to design, implement, and improve the service delivery process in both the service and product industries. Armistead (1996, 1998, 1999) considering the nature of business processes, suggests that it is useful to group processes into four categories: direction setting processes, operational processes, supporting processes and managerial processes. Davenport (2005) argues that companies seek to standardize processes for several important reasons. Within a company, standardization can facilitate communications about how the business operates, enable smooth handoffs across process boundaries, and make possible comparative measures of performance. Standard processes include *process activity and flow standards, such as* the SCOR (Supply - Chain Operations Reference), the "Process

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Handbook", the "Process Classification Framework " and eTOM. These are models or frameworks that are used in different types of operational processes. Garvin (1998, 2001) reviewing a wide range of process theories has grouped them into categories of processes: organizational processes and managerial processes. These are linked together as interconnected sets of processes within a unifying framework. Hammer (2002) in turn, considers effective for companies simply to determine five to ten important business processes. Kaplan and Murdock (1991) state that an organization generally has no more than three to four core processes that truly drive the realization of its strategic objectives. Other academics argue that a larger number of processes is needed, and about 20 would be a reasonable number (Davenport, 1993).

The competing views upon the kind and the number of processes can, to a large extent, be explained by the lack of a standard definition of the process concept and somewhat different purposes with process orientation. Moreover, it seems that the findings of most authors suggest that companies distinguish between two kinds of processes: key or core processes the outputs of which accomplish the aim of the company and satisfy customer needs; and support processes. Companies identify between three and ten core processes, while some other companies need a larger number of core processes, which constitute the bridge between strategy and daily operations. The possible ways by which these core processes are identified is an interesting area for special attention and research.

1.5   The role of measurement in process thinking

During the last decade, interest in measurements, not least business process measures, has exploded. Cost, productivity, time and quality are traditional categories that are also stressed in the total quality management (TQM) and process management literature (Harrignton, 1998, 1999; Davenport, 1995, 1996). For example, the measurement of process dimensions such as how much time is needed and also how much it cost to fill a customer order can be equally important compared to whether the order was filled flawlessly or precisely or whether the product was delivered to its destination. The objective of a process to provide value to its customer was presented previously as part of a basic definition. Therefore, customer satisfaction is also a key measure, which influences the attainment of key process performance and needs to be an integrated part of process management (Davenport, 1996; Armistead, 1996). Other dimensions of process measurement that have been discussed during the last years include organizational learning and development of the human capital (Garvin, 1993; Armistead, 2000; Davenport, 2002). The importance of creating a balanced measure picture for the organization as a whole and some value creating processes in particular has been stressed by Kaplan & Norton (1996, 2004). Moreover, Davenport (1995) associates process measures with learning, using the term "double-loop learning" of Argyris and Schön (1978). Using the first loop, he measures a narrowly defined task and its outcome, focusing on the worker, the process and its output. The other loop of double-loop requires measures and evaluation of the broader goals of key processes, judging the relevance of the processes to the environment. In moving to a process enterprise, Hammer (1990, 1999) reinforces aspects of process performance that are most directly linked to achieving the organization's overall objectives.

The performance of a process should be measured using financial and non-financial outcomes and indicators. Measuring each process end- to-end and aggregating these measures up to top-level businesses results is crucial and very important. They create a set or a balanced system of measures that helps the organization manage the most important process across the different functional silos to achieve business goals that satisfy stakeholders' needs.

2.   Identification of processes

One of the structural issues that is crucial in process management and is emphasized by the above analysis is the key process identification theme. Today, many companies facing ever more demanding customers are constantly trying to attain improved performance from their operations by following a number of popular programs, including TQM, BPR, Balanced Scorecard or Six Sigma, under a process management philosophy (Hammer, 2002; Armistead 1999).

To start down the road to process orientation, a company must first recognize and name its processes. The identification, naming and communication of a company's key processes is a important step. Identification of the wrong processes could cause important operational and financial problems for a company. But selecting the right processes concerned with setting the strategy for a company as well as managing resources within the company, products and services will be produced in an efficient and effective way that will achieve goals and satisfy needs. A number of articles have addressed the importance of identifying core processes key elements for making the decision on core process identification. Basically, the core processes of an organization achieve business goals and their identity depends on the company's industry and the key results it produces for its customers (Hammer, 2002; Armistead,1999; Kaplan and Murdock,1991, Davenport, 1993, 2005). Though, sometimes they are related to the form of the matrix organization already in place, core processes should be identified through a customer-driven analysis.

Armistead (1999) has found that companies conduct an analysis of its external market value chain and identifies its key business processes in relation to this. However, the initial identification of processes may lead to too many business processes. Thus, emphasis should be given on introducing BPM at the top level of the organisation, revealing that the majority of organisations identified fewer processes (at the highest level) than the early stage sample for both operational and support processes. Hammer (2002) states that generally, companies find it effective to identify five to 10 major business processes. The author considers process identification complicated due to the fact that a process transcends functional boundaries; for example, order fulfilment cross-functional areas and integrates customer service, logistics, finance and even manufacturing to serve a common goal. The process owner is defined as a key figure, ensuring peak performance of a business process which is derived from customer and shareholder needs as well as it is aligned and integrated to achieve the strategic goals. The process owner employs different methods and tools such as the SIPOC (supplier, input, process, output, customer) model and a process map to document process steps. Identification which business processes are critical, based not only on the enterprise's vision, but also the core competencies of the company is suggested by Meade L., and Rogers (1998)

Sinclair D. and Zairi M. (1995) in one of the early works on effective process management developed an integrated model of total quality – based performance measurement system. The second level of the system – model is referred to process management and measurement. The first step in this model system is to identify and map processes, including identification of critical partners and elements such as: process customers and suppliers (internal and external); customer requirements (internal and external); core and non-core activities; measurement points and feedback loops. One of the levels of Harrington's (1995) Total Improvement Management (TIM) pyramid refers on the identification of organization's processes, stressing the output that its customers receive. It is emphasised that the building blocks of the pyramid makes use of many different streamlining techniques, including value-added analysis, benchmarking, and information technology. As reported by a case study (Nickols,1998) another approach is to identify the outputs being delivered and then work backwards from there to identify the processes that yield these outputs, utilizing Quality tools and techniques.

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Davenport (2005) referring to managers who have to decide which of their processes are core in order to make their strategies succeed and which can be performed in a relatively generic and low-cost fashion, emphasizes the need not only to consider traditional tools and techniques but also process standards. Especially, process activity and flow standards are used to communicate easily and efficiently when describing processes in an organization and organizing process benchmarks.

It seems that identification of key processes must be associated with critical partners and elements. These typically consist of customers or other stakeholders, strategy, business goals, and outputs. Also, several tools and techniques have been proposed for supporting process identification and analysis.

2.1 Tools and Techniques

The purpose of using tools and techniques is so that the process owner and teams can base their decisions on objective data rather than subjective feelings. By using techniques to support process analysis recommendations, teams will be better positioned to overcome barriers and obstacles and will more readily secure approval to proceed with process identification efforts. A single tool is a device with a clear function, and is usually applied on its own, whereas a technique has a wider application and is understood as a set of tools (McQuater et al., 1995). The quality and management tools and techniques can be mapped into representative key process themes or phases, as were derived above and shown in Table3. The most important of them are presented as follows:

Brainstorming - Brainstorming is one of the most widely used process management techniques. It is actually a disciplined form of creative thinking (McFadzean, 1999, 2000). It is a technique of creative thinking and is used for decision making through the formulation of ideas from team members with regard to a subject (Pissarra I., Jesuino I. C. 2005; Brahm and Kleiner, 1996). Brainstorming has mainly exploratory application without however any restrictions to be used for other methods and approaches (Seaker and Waller, 1996). It is a tool that has been used to help reveal and clarify for the organization its common but sometimes unconscious assumptions about the nature and management of the key business processes (EFQM, 2000).

Affinity diagram - Affinity diagramming is the organized, consolidated output resulting from a brainstorming session in which large amounts of data have been generated (Babbar et al., 2002; Anjard, 1995; Evans and Lindsay, 1996; He et al., 1996). It is used to group facts, opinions, ideas and customer needs when the issues being investigated are numerous and complex and the thoughts on how to deal with the issue are in disarray.

Relationship diagram - Relations diagrams are simple graphical representations of cause and effect with respect to a given problem or process. It is used in the problem identification and description phase of strategic quality planning when there is a need to clarify and understand complex relationships (Boisvert, 2004; Anjard, 1995; He Z et al., 1996. It shows the logical connections between ideas and problems, while the affinity diagram shows the associations. It has a network structure while the Ishikawa diagram has a tree structure.

Tree Diagram - The tree diagram is used in a top-down manner to break down a subject into successive levels of detail until implementation (*Stockle, 1995, Anjard, 1995)*. A main problem, a general goal or a main customer need can be broken down into its constituents. A business goal can be broken down into a series of process or activity goals. Therefore, it systematically shows the paths between objectives and gives a systematic view of how a result can be achieved. This allows a realistic implementation strategy to be generated and assessed.

Table 3. Technique application in the key process identification

Technique	Data/Needs Gathering	Data Analysis	Decision-support	Consensus Building
Activity-based Costing (ABC)		X	X	
Force field analysis		X	X	X
Hoshin planning			X	X
Program Decision Process Chart (PDPC)		X		X
Quality Function Deployment (QFD)	X	X		
Survey/interview	X			X
SWOT analysis	X			X
Pareto Analysis		X		
Cause and Effect analysis		X	X	X
Gantt charts				
Διαγράμματα Διασποράς				
Control charts	X	X		
Flow chart			X	
Affinity diagram		X		
Relationship diagram		X		
Histograms		X		
Benchmarking	X	X		
Brainstorming	X			X
Performance cell	X		X	
Data modeling		X	X	
Process modelling		X	X	
Economic analysis	X	X	X	
Simulation		X		
Nominal Group Technique		X	X	X
PERT		X	X	
Checksheets	X			

Matrix diagram - The matrix diagram is a tabular tool to facilitate the identification of relationships between two or more sets of factors (He et al. 1996, Stockley, 1995). It is applicable to planning, failure prevention, and so on. At each intersecting point of the matrix between a vertical set of items and a horizontal set of items a relationship is indicated as being either present or absent. Strengths of relationship between elements can also be determined. In its most common use the matrix diagram takes an input often form the tree diagram and graphically displays their relationship with people, processes or other themes (Anjard, 1995). There are a variety of different types of matrix diagram available to deal with different numbers of groupings and different types of relationships between these groupings. It is used for quality function deployment, allocation of tasks, clarifying relationships between defect phenomena and their causes, etc.

Quality Function Deployment - The QFD also known as the "House of Quality" and introduced in 1972 by Akao (Miguel, 2005; Akao and Mazur, 2003), is used basically to translate the "voice of customer" into product features (Özgener, 2003). Some of the acknowledged advantages of QFD include development of cross-functional teamwork, easier documentation, and, above all, customer satisfaction (Govers, 2001, Politis, 2003). QFD has

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been proved to be a successful tool to support a product design project. Moreover, the application of QFD to the process prioritization has been a popular approach.

All these techniques should be used to accomplish predetermined objectives. That is, to select a technique for a specific purpose and ensure that the purpose is fulfilled, as shown in Table 3. This matrix can be used as a guide for selecting techniques by key process identification phase. Putting together the critical phases of key process identification and considering the features of process management techniques a framework can be formed. Linking these factors into a system model or framework is a source for operational effectiveness.

2.2   Framework of key process identification

Some of the articles in the literature combined popular models or frameworks to deal with process identification, such as the BEM-EFQM, the Baldridge Award, the Deming Award, the Balanced Scorecard and the 6 sigma.

Hammer (2002) considers six-sigma methodology to identify "primary" activities or "secondary" ones. The concept of the "value chain" is used to provide an answer. A starting point to identify core processes is the definition first of major activities through which companies provide value – products and services – to customers, and then of the primary Outputs of each process. Thus using six-sigma methodology, business processes are designed to be customer-driven, cross-functional and value-based. The concept of ''Value chain'' was defined by Michael Porter (1985) in Competitive Advantage. Value chain depicts a series of value-generating activities within an enterprise. It provides substantial linkage of activities to bottom line business results and integrates key activity functions. ISO 9001:2000 Quality Standard requirements, make also use of the concept of value chain, stressing the need for a company to identify the processes used for the Quality Management and determine the relation and the interaction of these activities (Biazzo, S. and Bernardi, G. 2003).

Armistead (1999) proposed the TQM frameworks, such as the Baldridge Award and the EFQM Model for companies that they want to address the key process identification problem. One of the core values and concepts of the American Baldridge Award is Process Management. The process Management Category examines the key aspects of an organization 's process management, including organizational value and key support processes. The identification of key processes are associated with a) key products or services, b) creation value for the company, customers, and other stakeholders, c) profitability and business success and d) key performance measures. The EFQM Excellence Model is a non prescriptive framework based on nine criteria (EFQM, 2003). Five of these are ''Enablers'' and four are ''Results''. Excellent Organization implements their mission and vision by developing a stakeholder focused strategy. Policies and strategies are deployed through a framework of processes. This includes identifying and designing a key process framework.

Most of the articles considering models or frameworks to deal with process identification are limited only to state the critical elements of the problem. In summary, research on process identification covers only a number of issues related to the topic. None of the work reported is focused on putting together critical elements of process identification to form a framework. However, this paper utilises an extract from an EFQM Benchmarking Group report on Process Management (EFQM, 2000). EFQM links fundamental TQM concepts with the Business Excellence Model. Excellent results with respect to performance, customers, people and society are achieved through Leadership driving Policy and Strategy, People, Partnerships and Resources, and Processes. Processes are at the heart of the EFQM Business Excellence Model. Thus, Organizations need to have clear statements of Vision, Purpose and Values that allow them to set strategies and plans for achieving their Mission. These strategies and plans set out the Organization's objectives and targets and it is the organization's key processes that

will deliver those organizational goals. These elements are parts of the identified key process themes in Section 2 of this paper. The Figure 1, which is a slightly differentiated work of the EFQM Benchmarking Group, can be used as a suitable framework to key process identification problem.
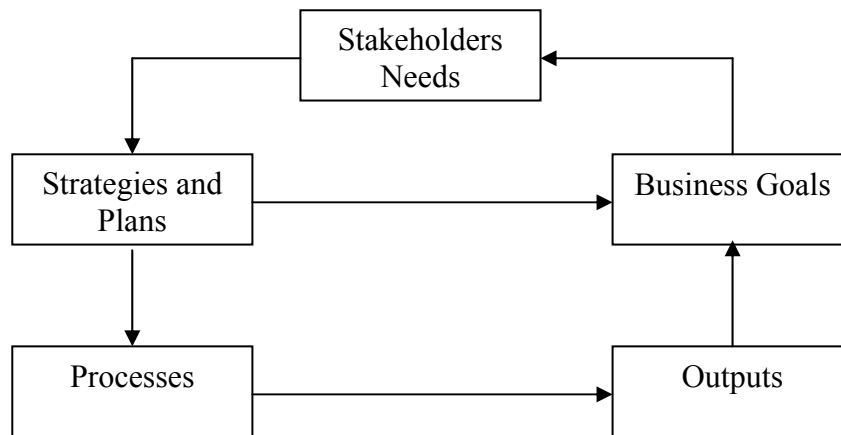

Figure 1. Key process identification framework (EFQM, 2000)

Based on this framework, the needs of all stakeholders help define the strategies and plans for the Organizations. These strategies and plans, in turn help to identify the key processes, the outputs of which, will satisfy the Stakeholders' needs. Being the basis for the key process identification framework, each of the principle as determined in Section 1.2 has number of direct or indirect link to different elements or phase of the framework. The process management techniques are used to accomplish predetermined objectives, as shown in Table 3. Key Process identification is accomplished by the process owner and cross-functional teams working together. The more useful the data that are gathered from all stakeholders needs the more effective key process identification efforts will be. It is important that when a technique is used to generate decision-support data, the data itself is neutral, balanced, and factual. At the conclusion of every phase in the framework, there should be team consensus on the results obtained, the meaning of those results, and the application of the results in subsequent steps.

At the heart of the framework lies a causal logic based on lead and lag types elements, grouped into five areas. The five cause-related chain areas are:
- Stakeholder: What do they want? How do they think?
- Strategy: How do we want to achieve?
- Process: How will we do it?
- Output: What have we achieved?
- Goal: How will we know?

As a consequence of the causal framework logic, the key process identification problem can be supported by using relevant techniques from Table 3.

Summary and Conclusions

This paper summarizes in brief relevant knowledge associated with the application of process management principles and elements to key process identification. Basic process definitions are singled out and presented in conjunction with resulting value, customer and stakeholder. The lack of a standard definition creates much of the difficulty in identifying key business processes. However, principles based on systems thinking could make clearer the meaning of

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processes. These principles should deal with company's results, identification of relevant sub-processes, standardization and measurement of processes, learning and continuous improvement, as well as process owners and process teams identifying, utilising the appropriate supporting tools and techniques. Companies distinguish between two kinds of processes: key or core processes and support processes. Companies identify between three and ten core processes, which constitute the bridge between strategy and daily operations. The performance of a core process should be measured using a balanced system of financial and non-financial outcomes and indicators that help the organization manage the most important process to achieve business goals that satisfy stakeholders' needs. Stakeholders needs, strategies and plans for the Organizations, processes, outputs of processes, and business goals that are critical elements of process management are revised and introduced into a key process framework.

In the context of the proposed framework, selected Quality and Management tools and techniques may be utilised in key process identification. Further work is aimed to refine the proposed framework and detail the use of selected tools based on key process identification.

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A control chart of the Weibull percentiles via Bayesian - bootstrap approach

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ABSTRACT

Purpose: This work proposes an innovative control chart of the Weibull percentiles using Bayesian estimators supported by bootstrap methods.

Approach: The chart offers two main advantages.

On one side, the estimation procedure is able to effectively integrate both the experimental and the technological information exploiting some specific Bayesian estimators.

On the other side, the bootstrap techniques allow to capitalize the experimental information provided by few samples.

Findings: The performance of the control chart has been investigated by means of a large Monte Carlo study.

Value of the paper: The paper presents a control chart for Weibull percentiles, where few alternative charts can be found.

Keywords: Statistical Process Control, non-Normal control charts, Bayesian inference, Weibull distribution, Bootstrap methods

Category: Research Paper

INTRODUCTION

The common Shewhart-type control charts are widely employed to monitor quality of products and services in order to detect shifts (step changes or gradual drifts) in the mean and/or variance of a quality characteristic of interest. However, these charts work satisfactorily if the underlying distribution of the observed data is Normal or near-Normal and the sample size is large enough. This assumption allows one to exploit the "normalizing effect" and to theoretically derive the sampling distribution of the parameter estimator.

Anyway, this assumption is not valid in several technological contexts where the quality is measured in terms of reliability. Nearly always, the distributions of the reliability parameters are

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skewed and the "normalizing effect" of Shewhart control charts is not effective or impossible due to the extremely small size of the available samples. Unfortunately, few papers dealing with non-Normal populations and reliability control can be found in literature (Padgett and Spurrier, 1990), (Kanji and Arif, 2001), (Xie *et al.*, 2002), (Shore, 2004), (Zhang and Chen, 2004), (Nichols and Padgett, 2005).

Moreover, in these alternative charts, reliability control is performed via a pure classical statistical approach, ignoring all the available technological knowledge. Anyway, in facing very small samples, these classical estimation procedures can be misleading as shown in (Canavos and Tsokos, 1972, 1973), (Smith and Naylor, 1987) and (Erto, 2005).

To overcome all these difficulties we can use reliability estimators based on the application of the Bayes theorem, that has got the peculiarity of allowing one to integrate both the experimental and the technological information.

Moreover, within a Bayesian framework bootstrap techniques can be used to support the estimation procedure, in order to capitalize the experimental information provided by few samples.

The control chart proposed in this work exploits some specific Bayesian reliability estimators known as "Practical Bayes Estimators" (PBE) in order to monitor a specified percentile of the underlying Weibull distribution of the characteristic of interest. These estimators were first introduced in (Erto, 1982) and then applied in several technological contexts during past years (Erto and Rapone, 1984), (Erto and Lanzotti, 1990), (Erto and Giorgio, 1996), (Erto, 2005), (Erto and Pallotta, 2006), (Erto and Pallotta, 2007) and (Erto *et al.*, 2008).

In the first sections the main steps are presented which led to estimate the sampling distribution of the Bayesian estimator for the Weibull percentile by means of the "parametric bootstrap sampling". Then this empirical sampling distribution is exploited to draw a Shewhart-type control chart for Weibull percentiles. The performance of the chart is investigated by means of a large Monte Carlo study and a comparative analysis of its responsiveness is reported.

Acronyms & Notation

$\mathrm{Sf}\{\cdot\}$	survival function
$\mathrm{pdf}\{\cdot\}$	probability density function
R	reliability level
K	constant equal to $\ln(1/R)$
x_R	$1-R$-th percentile of the Weibull distribution such as that $\mathrm{Sf}\{x_R\}=R$
$E\{x_R\}$	anticipated (mean) value given by prior knowledge for x_R
n	sample size
$\underline{x}$	n-dimensional sample array
k	number of available samples
M	number of bootstrap training samples
B	number of pseudo-random samples from estimated Weibull distribution
α	tail areas of a pdf corresponding to a given false alarm risk
δ, β	scale and shape parameters of the Weibull distribution
a, b	scale and shape parameters of the Inverse Weibull prior distribution of x_R
β_1, β_2	prior numerical interval for β
$\wedge$	implies an estimate.
PBE	Practical Bayes Estimators (or Estimates)
L	Likelihood Function
MLE	Maximum Likelihood Estimators (or Estimates)

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1 THE RELEVANCE OF THE WEIBULL PERCENTILES IN RELIABILITY CONTROL

In reliability problems, the control of the Weibull percentile x_R is strategic. The choice of x_R is justified by the wide use of this parameter in:

- defining warranty conditions;
- developing contractual specifications;
- characterizing norm requirements;
- expressing key-indicators in engineering catalogues.

In practical situations the control of a specific Weibull percentile becomes crucial when the quality characteristic of interest is the breaking strength of brittle materials (such as carbon, boron), the compressive strength of specimens made with quasi-brittle materials (such as concrete, rock, ice, ceramic and composite materials concrete) and the tensile adhesive strength (Park, 1996). In these contexts, a minimum strength value is required for engineering design and monitoring the mean and variance of the strength distribution (by means of classical control charts) could be seriously less effective than monitoring lower percentiles since a small variation in mean and/or variance can produce a significant shift in the small percentile of interest as shown in (Padgett and Spurrier, 1990) and (Nichols and Padgett, 2005).
Moreover, we must outline that, if the reliability level of the tested items is very high, we are able to collect very few data which prevent us to use classical control charts. In these cases, the proposed Bayesian approach may result an appropriate one.
The Weibull survival function is:

$$\mathrm{Sf}\{x; \delta, \beta\} = \exp\left[-\left(x/\delta\right)^{\beta}\right]; \qquad x \geq 0; \qquad \delta, \beta > 0 \tag{1}$$

that can be immediately reparameterized in terms of the percentile x_R and shape parameter, β, in which the Engineers' knowledge can be more easily converted:

$$\mathrm{Sf}\{x; x_R, \beta\} = \exp\left[-K\left(x/x_R\right)^{\beta}\right]; \qquad x \geq 0; \qquad x_R, \beta > 0 \tag{2}$$

$$K = \ln\left(1/R\right)$$

x_R and β both being unknown.

In the above engineering context, very good knowledge exists about the mechanism of failure under consideration, which can be converted into quantitative form about β. In particular, the engineers working in these well known contexts usually know more than the simple order of magnitude of the reliability performance which the produced item has, e.g., he has a quite precise knowledge about an x_R. Then, with both these pieces of information, he can formulate a numerical interval $\left(\beta_1, \beta_2\right)$ for β and an anticipated value for x_R. The PBE allow combining this prior knowledge about β and x_R with a few experimental data to give very good Weibull parameter estimates.

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2   THE BAYES APPROACH IN RELIABILITY PROBLEMS

2.1   Technological knowledge and prior distributions

In order to evaluate the PBE of the Weibull parameters, the following main elementary steps must be performed. For a comprehensive discussion of the assumptions on which the resulting estimates are based see (Erto, 1982) and (Erto, 2005).

The prior knowledge for β is converted into the values β_1 and β_2, using the well known relationship between the mechanism of failure and the value of β (e.g., early failures imply $\beta < 1$; chance failures imply $\beta = 1$; wear out failures imply $\beta > 1$).

These two parameters can be effectively and easily anticipated since the Engineers' information, about the mechanism of failure, can be always expressed in terms of an interval (β_1, β_2). This interval must be chosen wide enough in order to plausibly contain the unknown (true) value of the Weibull shape parameter.

The only restriction, which the anticipated values β_1 and β_2 must be subjected to, is the following one:

$$\beta_1 + \beta_2 > 2 \tag{3}$$

since their sum will be used to set up the argument of the Gamma function in (6).

For a selected percentile x_R (corresponding to the R value of interest) the prior probability density function is assumed to be the Inverse Weibull (Johnson *et al.*, 1994):

$$\text{pdf}\{x_R\} = a\,b\,(a\,x_R)^{-(b+1)} \exp\left[-(a\,x_R)^{-b}\right]; \qquad x_R \geq 0; \qquad a, b > 0 \tag{4}$$

where a and b are scale and shape parameters respectively. The prior information for x_R is converted into the mean value of the probability density function (4):

$$E\{x_R\} = \frac{\Gamma(1 - 1/b)}{a} \tag{5}$$

Then, an effective value for the prior parameter a is automatically obtained by means of the (5):

$$a = \frac{\Gamma\left(1 - 1/\beta_m\right)}{E\{x_R\}}; \qquad \beta_m = (\beta_1 + \beta_2)/2 \tag{6}$$

since it is reasonable to assume $b = \beta_m$, as discussed in (Erto, 1982).

2.2   Reliability tests and Practical Bayes Estimators

Usually, in reliability tests, a sample array $\underline{x}$, of n experimental data, is available. If the selected reliability parameters of the items are characterized by the model (2), the following joint posterior probability density is obtained:

$$\text{pdf}\{x_R, \beta \,|\, \underline{x}\} = \frac{\beta^{n+1}\, a^{-\beta}\, x_R^{-\beta(n+1)-1} \prod_{i=1}^{n} x_i^{\beta-1} \exp\left[-x_R^{-\beta}\left(a^{-\beta} + K \sum_{i=1}^{n} x_i^{\beta}\right)\right]}{n! \int_{\beta_1}^{\beta_2} \beta^n a^{-\beta} \prod_{i=1}^{n} x_i^{\beta-1} \left(a^{-\beta} + K \sum_{i=1}^{n} x_i^{\beta}\right)^{-(n+1)} d\beta} \tag{7}$$

We can say that this density function describes the residual uncertainty which exists about the two parameters. So we could estimate the parameters x_R and β adopting their modal or median or mean values. The PBE choose the last ones, that is, the expectations of x_R and β:

$$E\{x_R \mid \underline{x}\} = \frac{I_3}{I_1}; \qquad E\{\beta \mid \underline{x}\} = \frac{I_2}{I_1} \qquad (8)$$

where:

$$I_j = \int_{\beta_1}^{\beta_2} \beta^{m_j} a^{-\beta} \prod_{i=1}^{n} x_i^{\beta-1} \left(a^{-\beta} + K \sum_{i=1}^{n} x_i^{\beta}\right)^{-(n+1)+k_j} \Gamma\left(n+1-k_j\right) d\beta \qquad (9)$$

$$j = 1, 2, 3$$

with the following values for the parameters m_j and k_j:

$$m_1 \equiv m_3 = n; \quad m_2 = n+1; \quad k_1 \equiv k_2 = 0; \quad k_3 = 1/\beta. \qquad (10)$$

3 BOOTSTRAP TECHNIQUES APPLIED TO CONTROL CHARTING

During past years, bootstrap methods have gained an increasing acceptance in Statistical Process Control charting, being mainly used to find more appropriate control limits when the distribution of the observed process is unknown or non-Normal (Nichols and Padgett, 2005). In control charting the main effect of non-Normality is the difficulty to theoretically derive the sampling distribution of the selected parameter estimator. The problem is quite crucial since an appropriate knowledge about the sampling distribution influences the correct setting of control limits, according to the desired false alarm risk α (Wood et al., 1999). Bajgier (1992) proposed a non-parametric bootstrap control chart to monitor process mean in case of non-Normal populations. He does not assume a distribution model but only a stable and in control process when the control limits are computed.

In (Seppala et al., 1995) a bootstrap technique based on subgroups is proposed, removing the assumptions made in (Bajgier, 1992) and computing control limits using bootstrapped residuals. The available alternatives show the convenience in exploiting bootstrap methods to set up more realistic Shewhart-type control charts, able to correctly detect process shifts when the underlying distribution of the quality characteristic of interest is non-Normal.

Within this framework, a stream of research has been developed to effectively combine Bayesian estimation procedures and bootstrap techniques starting from (Laird and Luis, 1987) and (Carlin and Gelfand, 1991). The bootstrap is applied to introduce the uncertainty related to prior distributions which are estimated from data.

This approach is known as "parametric bootstrap sampling" and the control chart proposed in this paper can fit in it.

3.1 A PBE-bootstrap control chart of the Weibull percentiles

In order to construct the PBE-bootstrap control chart, obtained by integrating the PBE with the "parametric bootstrap sampling" approach, the following operative steps are presented:

Phase 1 - The training resampling procedure

1. From an in-control process, we collect k samples with sample size n. We assume that samples come from a Weibull distribution (2) with unknown parameters x_R and β. Some specific Weibull probability plots and goodness-of-fit tests (Shapiro, 1990) can be employed to check this assumption. We can decide which samples are to be

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used to estimate the control limits and, as suggested in (Wood *et al.*, 1999), we could remove those judged as not typical of the process (on the basis of an earlier trial run of resampling procedure). However, in this work, we use all the k samples.

2. We pool all the observations into a single "combined sample" and, thanks to the bootstrap approach, we use it as a surrogate for the Weibull population. We assume that the "combined sample" provides an adequate picture of observations from the process and that the process is stable.

3. We resample from the "combined sample" M times obtaining M "resamples" of size *n*. It is generally sufficient $M = 1000$.

4. For each resample, we obtain an x_R estimate $\hat{x}_{R,j}$ and a β estimate $\hat{\beta}_j$ $\left(j = 1, ..., M \right)$, using some classical estimators for Weibull parameters (such as MLE). Alternatively, the first and second estimators (8) can be used to calculate $\hat{x}_{R,j}$ and $\hat{\beta}_j$, (e.g., in place of the MLE), if a real prior technological knowledge exists and, so, a prior interval $\left(\beta_1, \beta_2 \right)$ for β and an anticipated value $E\{x_R\}$ for x_R can be formulated.

5. Then, we can calculate the averaged robust estimates $\hat{x}_{R,0}$ and $\hat{\beta}_0$ over the all M "resamples".

Phase 2 - The empirical sampling distribution

1. We replace the unknown Weibull parameters with the estimates $\hat{x}_{R,0}$ and $\hat{\beta}_0$. At the same time, these values are used to update the prior interval $\left(\beta_1, \beta_2 \right)$ for β and the anticipated value $E\{x_R\}$ for x_R needed to calculate parameter estimates from the future small samples to be collected.

2. We generate a sufficiently large time B (i.e., 10000) of "parametric bootstrap samples" $\underline{x}^*$ of size n from the estimated Weibull distribution. Using the first estimator (8), we obtain B estimates $\hat{x}_{R,i}^*$ $\left(i = 1, ..., B \right)$.

3. The frequency distribution of these estimates represents an empirical sampling distribution of the Weibull percentile estimator (8).

We must note that this distribution is conditioned to the above value $\hat{\beta}_0$ assumed for β. We used this robust $\hat{\beta}_0$ estimate (based on $M = 1000$ resamples) since the value of the shape parameter can be considered constant, being closely linked to the unchanged mechanism of failure. Technological knowledge and engineers' experience proved this assumption (Steiner and MacKay, 2001), (Zhang and Chen, 2004).

Phase 3 - The estimation of statistical control limits

The Lower Control Limit (LCL) is the value corresponding to the smallest ordered $\hat{x}_{R,i}^*$ such that $\left(\alpha/2 \right) \times B$ values are below it, where α is the fixed false alarm risk.

The Upper Control Limit (UCL) is the value corresponding to the smallest ordered $\hat{x}_{R,i}^*$ such that $\left(\alpha/2 \right) \times B$ values are above it.

The Center Line (CL) is the value corresponding to the median of the ordered $\hat{x}_{R,i}^*$.

In the special case we want to set a Shewhart-type control chart, we can set $\alpha = 0.0027$ and we obtain the corresponding needed control limits.

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Once the control limits are obtained, the chart can be operatively used to implement the control of the Weibull percentile x_R, using the first estimator (8) at each sampling stage.

4 PERFORMANCE ANALYSIS

In this Section we report a Monte Carlo study carried out to investigate the performance of the proposed chart. As suggested in (Nichols and Padgett, 2005), the in-control Average Run Length (ARL) was calculated by generating $k = 20$ samples of size $n = 5$ from a Weibull distribution with shape parameter β_0 and percentile $x_{R,0}$. In order to comparatively evaluate the performance, we set a Shewhart-type control chart based on a theoretical false alarm risk $\alpha = 0.0027$. The control limits are calculated following the all operative steps of the procedure described in Section 3.1. Once the chart is ready to be employed, further samples are simulated from the same Weibull distribution and the percentile x_R is estimated until a point falls outside of the control limits. The in-control run length can be measured as the number of samples extracted up to and including the first out-of control signal. We repeat the whole simulation obtaining 500 replications of the run length. The in-control ARL can be computed averaging over the all 500 replicated run lengths.

In Table I we report the results of this simulation study. We considered two different lower percentiles $x_{0.90}$ and $x_{0.99}$ corresponding to the high reliability levels $R = 0.90$ and $R = 0.99$, respectively.

The chart works reliably: when the process is in-control the ARL value is close to the theoretical value 370 corresponding to $\alpha = 0.0027$.

Table I In-control ARL measures $\left(\alpha = 0.0027, \ n = 5 \right)$

In-control Weibull parameters		Percentile of interest	
β_0	$x_{R,0}$	$x_{0.90}$	$x_{0.99}$
2	0.10	**383.2**	**360.5**
3	0.21	**388.2**	**379.7**

Similarly we computed the out-of-control ARLs by simulating some specific percentile shifts to be detected as critical out-of-control conditions, using the same values studied in (Nichols and Padgett, 2005). In Table II we report the results of this simulation study.

As we can see the responsiveness of the chart is good and the out-of-control ARL values are competitive with those presented in (Nichols and Padgett, 2005), being the advantage increasing as sample size of the available samples decreases.

Table II Out-of-control ARL measures $\left(\alpha = 0.0027, \ n = 5 \right)$

In-control Weibull parameters		Out-of-control Weibull parameters		Percentile of interest	
β_0	$x_{R,0}$	β_1	$x_{R,1}$	$x_{0.90}$	$x_{0.99}$
1.5	0.046	1	0.01	**27.6**	**25.7**
3	0.21	2	0.10	**31.2**	**26.8**

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5   Concluding remarks

This work has shown how to effectively combine the Bayesian approach and the bootstrap techniques in order to set up a reliable control chart for Weibull percentiles.

Thanks to the bootstrap methods used, the proposed procedure enables one to estimate robust control limits and to easily implement a Shewhart-type control chart when the underlying distribution is not-Normal and the sample size is small. In the examined cases, the chart is competitive to the available alternative charts. Moreover, thanks to the Bayesian nature of the employed estimators the chart turns out to be particularly effective in critical situations when very small samples (also individuals) have to be processed

On the basis of some preliminary simulation studies the chart seems to work satisfactorily. Obviously, further and deeper research about its statistical properties is needed.

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Health Care Quality in Greek NHS Hospitals:
No one knows better than patients

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Abstract

Purpose: Healthcare organizations operating in the public sector are experiencing increasingly low trust on the part of the patients in terms of the quality of care provided. Today people hoping to receive high service quality tend to prefer private hospitals or even travel abroad. Thus, National Health System Hospitals are undergoing pressure from governments and the general public to improve their quality and compete effectively. With this in mind, the purpose of this paper is fourfold. *First,* to identify the relevant service - quality dimensions used by Greek patients to evaluate service quality. *Second,* to assess patients' perceptions and expectations related to the quality provided by public hospitals. *Third,* to investigate how closely patients' perceptions and expectations of service quality match. *Fourth,* to determine the relative importance of quality dimensions in influencing patients' overall quality perceptions.

Methodology: Empirical research is used to determine patients' perceptions and expectations of service quality in NHS hospitals located in North Greece. In this study SERVQUAL instrument was used to measure the service quality. The SERVQUAL questionnaire included an expectations' and a perceptions' section, each consisting of 26 statements. In addition, the questionnaire contained i) an extra section relating to demographics (e.g. age, gender, education) and ii) an overall question on the impression of quality of service provided. Due to the recognized instability of the dimensionality of SERVQUAL, it was considered necessary to test this instrument for its usefulness in the Greek hospital environment. Questionnaires were distributed and explained to the patients in the hospital wards on the day they were discharged from the hospital. One hundred and thirty seven (137) satisfactorily completed questionnaires were collected.

Findings: The analysis revealed that patients perceived receiving a rather satisfactory level of health care quality across all SERVQUAL dimensions. However, the results of this study showed that a gap exists between the rating which patients assign to expectations and to perception statements. In fact, expectations exceed perceptions of the provided service quality, suggesting that there is room for quality improvement initiatives. Finally, despite the criticism of the SERVQUAL instrument, in the present study it proved to be a useful tool (in terms of its validity and reliability) for

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measuring quality in the health care sector. Additionally, SERVQUAL can be considered as a flexible tool since it allows modification to incorporate the idiosyncrasies of specific industry or/and national context.

Originality/value of paper: This paper sheds light on a poorly researched field in the Greek context. The results clearly establish the areas where quality improvements are more demanding. Further, it provides directions for hospital managers and policymakers to develop strategies which will meet patients' expectations of service quality, restore patients' trust in public hospitals and increase thus their competitiveness. Finally, it gives support to the view that, although difficult, service quality in the health sector can be measured and consequently be monitored systematically in order to narrow previously identified gaps and take corrective actions when necessary.

Keywords: SERVQUAL, Public Hospitals, Greece, Research.

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Introduction

The Greek government addressing the long standing crisis in the health sector established the National Health System (NHS) in 1983 which is considered as a pathbreaking initiative in the health care field. The main goals of the reform were the separation of private and public sector, the empowerment of public health sector, the development of primary care, increases in public spending on health, decentralization, reorganization of hospitals, improvements in manpower policy, efficiency, equity in terms of equal accessibility and social control (Tountas et al., 1995). Several ambitious reform efforts followed in the next 24 years (1997, 2001). It is noteworthy to remark that in March 2004 the Ministry of Health care provision was renamed in Ministry of Health and Social Welfare (MOHAW) reflecting the contemporary human-centered approach to health care services provision which places at the heart of the system the respect and satisfaction of the physical, psychological and social needs of the health care service recipients. Further, the following 2005 reform (Law No. 3329/05) introduced the framework for Clinical Governance implementation which includes ten central pillars of action: economic rationalisation and sustainability of the NHS, establishment of a modern primary care network, dynamic promotion of proactive health care policy, introduction of information and new technologies in all administrative levels, new manpower policy, reform in psychological and public health, development of voluntarism and corporate social responsibility, education-research and innovation promotion, public and private sector partnership policy, promotion of the Greek health sector at the global market and health society (MOHAW, 2007).

Despite these efforts and reforms, healthcare organizations operating in the public sector in *Grece are still experiencing low trust* on the part of the *patients in terms of the quality of care provided and of the degree of responsiveness to patients' needs.* People hoping to receive high service quality tend to prefer private hospitals or even travel abroad. Thus, NHS Hospitals in Greece are undergoing pressure to improve their quality and compete effectively. Pressures both from the government and the general public which in its vast majority have low income and realise that they have no alternative to turn to(Karassavidou and Glaveli, 2007).

However, service *quality is an abstract, elusive and multidimensional construct* more difficult for consumers to evaluate than goods quality since it is evaluated both on the results obtained (technical quality) and the process of service delivery (functional quality) (Gronroos, 1983). Quality is even *more difficult to evaluate in the health care sector* due to the unique character of the service provided. Health care service is provided by professionals and frequently no tangible output is produced. Moreover, it is characterised by high involvement in the delivery process and low expertise of the purchasers/users, as well as by the risky nature of the service (Taner and Antony, 2006). On the other hand, patients are quite unique as customers they are worried about the outcome of the teatment, the process of being treated, the seriousenss of the underlying situation and are also anxious about those left back home. These characteristics make the conceptualisation and measuring of service quality in health care settings more important and more complex. Hospitals to maintain and improve the quality of service provided should not focus only on clinical and economic criteria. Patients' expectations and perceptions of care surveys are thus an important tool that managers and asministrators could utilise to evaluate and continuously monitor quality with the focus of tracing the weaker aspects of the health care delivery system.

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In this frame, *the purpose of this paper is fourfold. First,* to identify the relevant service - quality dimensions used by Greek patients to evaluate service quality. *Second,* to assess patients' perceptions and expectations related to the quality provided by public hospitals. *Third*, to investigate how closely patients' perceptions and expectations of service quality match (quality gap). *Fourth,* to determine the relative importance of quality dimensions in influencing patients' overall quality perceptions.

Service quality

Service quality has been revealed as a key factor in search for sustainable competitive advantage, differentiation and excellence in the service sector (Jabnoun and Al Rasasi, 2005; Jun et al., 1998). Also, it has been recognised as highly important for satisfying and retaining customers (Spreng et al., 1996; Reicheheld and Sasser, 1990).

Service quality has been approached as a multidimensional construct. SERVQUAL developed by Parusaraman et al. (1985; 1988), has been extensively accepted and utilised as a generic instrument that captures the multidimensionality of service quality. Parasuraman et al. (1985), had originally identified ten dimensions of service quality which were, at a later stage and after extensive explorative research and empirical testing, operationalised in five dimensions that included 22-items (Parasuraman et al., 1988). These five dimensions include:

1. *Tangibles*: physical facilities, equipment and appearance of personnel.
2. *Reliability*: ability to perform the service accurately and dependably.
3. *Responsiveness*: willingness to help customers and provide prompt service.
4. *Empathy*: caring and individualised attention provided to customers.
5. *Assurance*: employees' knowledge, courtesy and ability to convey trust and confidence.

According SERVQUAL service quality results from a comparison of expectations with perceptions of service quality. This is a *user-based approach* implying that customers have some expectations with respect to service performance prior to the delivery of service, which is compared with their perceptions of the actual service delivered. This comparison is not restricted only to the results of the delivered service but also to the process of service delivery and the interaction between the buyer and the seller (Gronroos, 1990)

The SERVQUAL approach has not been without its critics. There has been concern about the central role of expectations and the significance of a subtractive "gap" as a measure of quality (Asuboteng et al., 1996; Buttle, 1996). Moreover, the universality of SERVQUAL dimensons across different types of services has been questioned (Mostafa, 2006; Jiang et al., 2000; Babakus and Mangold, 1992; Carman, 1990). A further critic refers to its negglect of dimensions such as price and access (Gilmore and Carson, 1992).

Despite its critics, SERVQUAL has been widely used in many service industries including hotels, travel, higher education, real states, accountancy, architecture, construction services, hospitals, dentistry, call - centres (Foster, 2001). Indeed, *in health care most studies that explore quality apply SERVQUAL.* The focus of these studies varies and refers to: identification of the dimensions of service quality and assessment of the level of quality provided by hospitals or across a number of service categories provided by the hospital (Mostafa, 2006; Sohail, 2003; Wong, 2002; Lim and Tang, 2000; Tomes and Chee Peng NG, 1995; Sewell, 1997), comparisons on the level of quality provided between i) public and private hospitals (i.e. Camilleri and

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Callaghan, 1998; Jabnooun and Chaker, 2003; Taner and Antony, 2006) ii) different areas of hospital offerings: emergency room services, inpatient services and outpatient services (Reidenbach and Sandifer-Smallwood, 1990). Also, SERVQUAL was utilised in studies that refer to the development of scales to measure hospital service quality (Vandamme and Leunis, 1993; Tomes and Chee Peng NG, 1995) and investigation of the relationship between service quality and other variables such as leadership style (Jabnoun and Al Rasasi, 2005), patient satisfaction (Reidenbach and Sandifer-Smallwood, 1990; Andaleeb, 1998), patients willingness to recommend the hospital to friends (Reidenbach and Sandifer-Smallwood, 1990).

Methodology

Sample and Data collection
To determine patients' expectations and perceptions of service quality as well as the relevant quality gaps, a survey was conducted in six NHS hospitals located in North Greece. Questionnaires were distributed and explained to the patients in the hospital wards on the day they were discharged from the hospital. One hundred and thirty seven (137) satisfactorily completed questionnaires were collected.

Questionnaire design and structure
The SERVQUAL was used to measure service quality. More precisely, the questionnaire included an expectations' and a perceptions' section of service quality, each consisting of 26-items. The twenty-two (22) items were derived from Yousef et al., (1996) adapted version of the Parasuraman et al., (1988) SERVQUAL, to make it more relevant to hospital services. Based on the relevant literature (Lim and Tsang, 2000) and an evaluation by academics and medical practitioners one of the 22 -items was discarded and four extra items were supplemented to incorporate elements of price, access and catering. In addition, the questionnaire contained i) an extra section relating to demographics (age, gender, education and income) and ii) a question on the overall evaluation of the quality of service provided. The questions were close end. A seven-point Likert scale was used, where (1) is "strongly disagree" and (7) "strongly agree" meaning that higher scores indicate higher expectations and better patients' evaluations of the quality of service provided.

To assess the face validity of the questionnaire items, the scales that were initially in English were translated into Greek and then back- translated. Then, prior to data collection the questions were piloted through personal interviews with a sample of 5 patients. The corrections mainly concerned the phrasing of the questions in Greek.

Results and Discussion

Profile of the respondents
Female respondents represented a little more than 50% of the survey population. The largest groups of respondents (29.9%) were aged 41-50 years. The next largest groups, over 50 years and 26-40 years, represented 25.5% and 14.8% respectively. The smaller group of respondents (19.7%) was aged 18-25 years. Personal income was measured in euros and not surprisingly the vast majority of respondents, over 86%, reported a monthly income lower than 1500 euros, indicating that public hospitals are mainly used by people with low income who have no other choice. In

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terms of occupations about 50% of the respondents were employed in public and civil sectors, whereas 22.6% were self - employed.

Construct validity and reliability of the instrument
Considering i) the first objective of the present study according to which the major factors underlying the service quality provided by the Greek NHS hospitals are investigated and ii) the recognised in the relevant literature instability of the dimensionality of SERVQUAL, it was considered necessary to address the construct validity of the study.

It is noteworthy that in the literature about SERVQUAL, there is no agreement as to which scores (expectation, perception or quality gap scores) should be factor analysed to test for the dimensionality of service quality. Indeed, all three types of scores have been used in previous research (Vandamme and Leunis, 1993). In the present study we adopt Vogels et al (1989) view which suggest that the expectation scores should be factor analysed to determine the items that should be included in the service quality dimensions because "…these scores are not influenced by possible flaws in the service rendered by various firms in the industry…". Thus, in the present study, SERVQUAL scale was factor-analysed by principal component analysis in the expectation scores. A rotation procedure was applied to maximise the correlations of item on a factor (Comrey and Lee, 1991). After oblique rotation four factors were extracted. However, since the fourth factor included only one item "Doctors/staff would never be too busy to respond to patients request" it was decided to drop it. Consequently, three factors were finally considered (see Table 1). To measure the adequacy of the sample for extraction of the three factors the Kaiser-Mayer-Olkin (KMO) measure was computed. The KMO value (.931) indicates that the examined data set is highly adequate for factor analysis (Kim and Mueller, 1978). Moreover, the data set was found to be multivariate normal and acceptable for factor analysis according to Bartlett's test of sphericity (p = 0.000)

Total variance explained (67.558%) by these three components exceeds the 60% threshold usually accepted in social sciences to support the solution (Hair et al., 1995). The first factor, which explained 34.279% of the total variance, was labelled - The *human aspect* of the health care service quality. Factor 1 contains 16 items similar in nature to assurance, reliability and empathy in this sense it *could be regarded as the "soft" dimension of quality.* The second factor, explained 21.398% of the total variation and was labelled - *Physical environment and infrastructure.* This factor includes 7 items related to the tangibility of the provided service. Factor 3 explained 11.882 % of the total variance and was named *Access.* In this factor, two (2) items are included referring to access to the hospital services as well as to its facilities. The resulted third factor fully supports our decision to incorporate the relevant items in the SERVQUAL questionnaire.

The current research results highlighted that the structure proposed by Parasuraman et al., (1988) for the SERVQUAL scale was not confirmed. This finding is in line with previous relevant studies (i.e. Carman, 1990; Reidenbach and Sandifer-Smallwood, 1990; Lytle and Mokwa, 1992; Licata et al., 1995; Lim and Tang, 2000).

An internal consistency analysis was performed to assess the *reliability* aspect of the derived three dimensions. The value of the *alpha coefficient* ranged from .758 to .996 (alpha > .70, see Table 1) indicating that the three dimensions are reliable measures of service quality (Nunnaly, 1978).

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Descriptive statistics

I. Expectations
The mean scores of expectations were high (see Table 1) ranging from the lowest 5.66 for " Informative brochures about the provided service are available to patients" (item 23) to the highest 6.52 for " Doctors have a wide spectrum of knowledge and are competent" (item 16). The high mean values of the expectation scores have been anticipated and are in line with previous studies in the field (i.e. Taner and Antony, 2006). A possible explanation could be the difficulty to define the *adequate* and the *desired* level of service quality expectations due to the distinctive characteristics of the health care services and particularly its complex and risky nature. Indeed, the latest lead to the formation of a "*narrow zone of tolerance*" in the health care services compared to other service industries.

Among the three dimensions expectations are highest for *the human aspect factor* (mean score = 6.21), a dimension that covers the issues of caring, understanding, courtesy, inspiring security and trust, responsiveness, credibility and competence. *Access* (mean score = 6.12) which refers to accessibility in terms of facilities and services, follows. The dimension of *physical environment and infrastructure* has a mean expectation score of 6.01 and incorporates issues related to the tangible aspects of quality such as modern equipment, cleanliness, visually attractive environment, tasty meals and accurate procedures.

The patients' choices clearly show that four out of the five highest expectation score items (see Table 2) are related to the first dimension - *the human factor* - which turns to be the most critical of hospital services. In fact this findings reflects the *traditional view of the doctor-patient relationship* (Tomes and Chee Peg Ng, 1995). A relationship that emphasises doctors' competence in clinical skills, their ability to instil confidence and security in their patients and finally gain their trust. This is a message from patients to hospital managers and physicians/staff when dealing with patients. The five lowest expectation scores (see Table 3), in fact confirm the above since four out of the five are captured in the *physical environment and infrastructure dimension.*

II. Perceptions
The mean scores of the perception statements ranged (see Table 1) from 4.15 for "meals are tasty and adapted to patients nutritious needs" (item 22) to 5.34 for "Doctors have a wide spectrum of knowledge and are competent" (item 16). The only one item that scored lower than 4.15 was the item 24 "Informative brochures about the provided service are available to patients" (mean score = 2.85).

Among the three dimensions of service quality, patients appear to be more satisfied with *access* (mean score = 4.88) followed by *the human aspect factor* (mean score = 4.65) and *physical environment and infrastructure dimension* (mean score = 4.65). Probably, since patients feel little control over doctors in terms of being capable to judge their knowledge and expertise, they tend to be more critical with the hotel/tangible element of service. This is probably due to the fact that a comfortable, clean environment and good catering helps them relax and deal better with their anxieties.

The hospitals performed rather satisfactorily with regard to doctors' knowledge and competence (mean score = 5.34; See Table 4). Further, the staff was thought to be willing to help patients (mean score = 5.02). Also, patients gave a relative satisfactory score related to accessibility of the hospital facilities (mean score = 5.31). The

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evaluation of patients felt below 5 for " Patients feel secure in receiving medical care" (mean score = 4.96) and " Doctors and staff are always neat" (mean score = 4.90). Three out of the five items with the highest perception scores are included in *the human aspect* of the health care service quality dimension. On the other hand, it is noteworthy to remark that the least scored were items 22 (informative brochures) and 23 (meals). These items also received the lowest expectation scores (see Tables 2 and 4). Indeed, public hospitals are known (word of mouth impact on expectations formulation) for providing low quality of hotel services.

III. Gap scores and t-test

Gap scores were calculated for item and quality dimensions. The gap score for each item was computed by subtracting expectations from perceptions. Following, the gap scores for all the items in each dimension were added and divided by the number of items in the particular dimension (mean dimension quality gap). Using a two tailed test and a 5 per cent level of significance it was found that the differences between perceptions and expectations for each item, as well as for each of the three dimensions, are statistically significant since p value equals 0.000 for each item and dimension gap. Therefore, it could be concluded that *service quality gaps exist in Greek hospitals.*

It is interesting to point out that, in comparison to the other two dimensions, the *physical environment and infrastructure dimension obtained the lowest expectation and perception score* and at the same *the largest* quality gap (mean score = - 1.75; see Table 1). This finding suggests that there is a room for improvement on the part of the managers and administrators. Moreover, since this factor is related to tangibles it might contribute to depressing patients, who are in any case already worried about their health condition (Angelopoulou et al., 1998).

Three of the largest differences between expectations/perceptions (items 4,8,12) are in *the human aspect* dimension (see Table 6). Patients evaluations suggest that they are disillusioned regarding services being performed when expected, in relation to attention being paid and information provided concerning their medical condition. The rest two of the highest quality gap scores (items 17 and 23) are in the *physical environment and infrastructure dimension. They* refer to the lack of informative brochures available to patients and the adequacy of hospital equipment.

The hospitals appear to perform relatively better (see Table 7) as far as staffs' willingness to help patients and treat them with dignity and respect, as well as the knowledgeable and competent doctors, is concerned (items 3,16,10). These issues are included in *the human aspect* dimension. Accessibility to the hospitals facilities and doctors'/staffs' neat appearance present the less problematic areas of service quality delivery process.

IV. Relative importance of service quality dimensions

To examine the effect of the quality gaps - in the three dimensions - on the patients' overall evaluation of the quality of the service provided by the hospitals (general question in the questionnaire), regression analysis was performed. The three quality gaps were used as the predictors of overall quality of the services provided. Considering the independent variables with statistically significant coefficients, it is evident that patients' perceptions of service quality are attributed to *the human aspect quality* gap (see Table 8), which is in fact the predictor of overall service quality. The above research finding is a worth reporting since it indicates that the quality of the

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provided health care to patients treated in the Greek NHS hospital *depends heavily on improving the human aspect* of quality (Factor 1).

Nevertheless, it could be supported that this point of view reflects only one side of the coin. Quality improvement initiatives should address all the three factors since the quality gaps in the three factors since the quality gaps in the three dimensions proved to be statistically significant and highly correlated (see Table 9).

Conclusion

The present paper sheds light on a poorly researched field in the Greek context. It provides health care managers, administrators and policy makers with a conceptual and operational framework to measure and manage service quality. A frame that adopts patients' orientations since it integrates their expectations and perceptions related to the service provided. To the best of our knowledge, the broadly used SERVQUAL instrument was utilised for the first time in the health care sector in Greece. The results revealed that three dimensions of service quality capture the content of quality in the Greek context: *human aspect, physical environment/ infrastructure* and *access.* Despite the criticism of the SERVQUAL instrument, in the present study it proved to be a flexible, reliable and valid for measuring quality in Greek hospitals.

The analysis revealed areas in which hospitals are close to meeting patients' expectations and areas in which hospitals fall far short of expectations. This is particularly true in the case of the *physical environment and infrastructure* dimension followed by *human aspect and access.* In general, expectations exceed perceptions of the provided service quality, suggesting that there is room for quality improvement initiatives in all three dimensions. However, *the human aspect quality gap was found to be the most important area for improvement and in fact the predictor* of the overall service quality evaluation. The latest finding reveals the importance of building a *strong relationship* between patients and doctors/staff. A relationship based on respect, dignity, courtesy and genuine caring for the patients, putting it in other words to place the patient at the center of the health care system.

To sum up, the results clearly establish the areas where quality improvements are more demanding and have important implications for hospital managers, doctors/dtaff and policymakers. They give direction towards the development strategies which will meet patients' expectations of service quality, restor patients' trust in public hospitals and increase thus their competitiveness. Finally, it gives support to the view that, although difficult, service quality in the health sector can be measured and consequently be monitored systematically in order to narrow previously identified gaps and take corrective actions when necessary.

However, it should be kept in mind that patients' beliefs, perceptions and expectations can not be fully captured in a questionnaire. Therefore, the use of qualitative research along quantitative methods in future studies would provide a better understanding of the complex issue of quality in the health care sector.

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Table 1: Dimensions of health care service quality (based on patients expectations), mean scores for patients' expectations, perceptions and quality gaps and t-test

Items	Factor loadings	Mean expectation score	Mean perception score	Mean quality gap scores	t-value
Factor 1: Human aspect		**6.21**	**4.65**	**- 1.56**	**0.000**
(% of variance explained = 34.279; Cronbach's a = .996)					
1. Doctors / staff understand the specific needs of customers	.811	6.14	4.49	- 1.65	0.000
2. Doctors/staff should have patient's best interests at hart	.780	6.18	4.46	- 1.72	0.000
3. Patients should be treated with dignity and respect	.758	6.23	4.87	- 1.36	0.000
4. Doctors/staff should explain thoroughly medical conditions to patients	.750	6.14	4.36	- 1.78	0.000
5. Doctors/staff listen to patients and keep them informed	.745	6.17	4.49	- 1.69	0.000
6. Attitudes and behaviours of doctors/staff instil confidence in patients	.741	6.28	4.76	- 1.52	0.000
7. Friendly and courteous doctors and staff	.738	6.13	4.66	- 1.47	0.000
8. 24 hours service to patients is available	.733	6.21	4.39	- 1.82	0.000
9. Doctors/staff would give patients individualised attention	.720	5.98	4.20	- 1.78	0.000
10. Hospital staff is always willing to help patients	.709	6.11	5.02	- 1.09	0.049
11. Patients feel secure in receiving medical care	.618	6.32	4.96	- 1.36	0.000
12. Prompt service is provided to patients	.596	6.11	4.26	- 1.84	0.000
13. Error free documentation is provided	.594	6.27	4.67	- 1.60	0.000
14. Affordable charges for services are rendered	.584	6.23	4.67	- 1.55	0.000
15. Doctors/staff exhibit sincere interest in solving patients' problems	.567	6.31	4.80	- 1.51	0.000
16. Doctors have a wide spectrum of knowledge and are competent	.563	6.52	5.34	- 1.18	0.000
Factor 2: Physical environment and infrastructure		**6.01**	**4.26**	**-1.75**	**0.000**
(% of variance explained = 21.888; Cronbach's a = .915)					
17. The hospital's equipment is up-to-date and well maintained	.756	6.20	4.31	- 1.88	0.000
18. Services are provided at appointed time	.738	6.14	4.38	- 1.76	0.000
19. Clean, comfortable and visually attractive environment	.709	5.91	4.39	- 1.52	0.000
20. Doctors and staff are always neat	.697	5.98	4.90	- 1.08	0.000
21. Services are carried out right at the first time	.672	6.28	4.84	- 1.44	0.000
22. Meals are tasty and adapted to patients' nutritious needs	.632	5.87	4.15	- 1.72	0.000
23. Informative brochures about the provided service are available to patients	.563	5.66	2.85	- 2.80	0.000
Factor 3: Access		**6.12**	**4.88**	**-1.24**	**0.000**
(% of variance explained = 11.882; Cronbach's a = .758)					
24. The hospital is easily accessible (e.g. parking facilities)	.781	6.17	5.31	- .85	0.000
25. Hospital services are easily accessible	.745	6.08	4.45	- 1.63	0.000

Note: Extraction method: principal component analysis,
Scores based on 7-point scale ranging from 1= strongly agree and 7= strongly disagree,
All-means significantly different between expectation and perception scores at 95% confidence level (2-tailed tests)

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Table 2: The five statements with the highest expectation scores

Items	Mean expectation score
16. Doctors have a wide spectrum of knowledge and are competent	6.52
11. Patients feel secure in receiving medical care	6.32
15. Doctors/staff exhibits sincere interest in solving patients' problems	6.31
21. Services are carried out right at the first time	6.28
6. Attitudes and behaviours of doctors/staff instil confidence in patients	6.28

Table 3: The five statements with the lowest expectation scores

Items	Mean expectation score
23. Informative brochures about the provided service are available to patients	5.66
22. Meals are tasty and adapted to patients' nutritious needs	5.87
19. Clean, comfortable and visually attractive environment	5.91
9. Doctors/staff would give patients individualised attention	5.98
20. Doctors and staff are always neat	5.98

Table 4: The five statements with the highest perception scores

Items	Mean perception score
16. Doctors have a wide spectrum of knowledge and are competent	5.34
24. The hospital is easily accessible (e.g. parking facilities)	5.31
10. Hospital's staff is always willing to help patients	5.02
11. Patients feel secure in receiving medical care	4.96
20. Doctors and staff are always neat	4.90

Table 5: The five statements with the lowest perception scores

Items	Mean perception score
23. Informative brochures about the provided service are available to patients	2.85
22. Meals are tasty and adapted to patients' nutritious needs	4.15
9. Doctors/staff would give patients individualised attention	4.20
12. Prompt service is provided to patients	4.26
17. The hospital's equipment is up-to-date and well maintained	4.31

Table 6: The five statements with the highest quality gap scores

Items	Mean quality gap scores
23. Informative brochures about the provided service are available to patients	- 2.80
17. The hospital's equipment is up-to-date and well maintained	- 1.88
12. Prompt service is provided to patients	- 1.84
8. 24 hours service to patients is available	- 1.82
4. Doctors/staff should explain thoroughly medical conditions to patients	- 1.78

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Table 7: The five statements with the lowest quality gap scores

Items	Mean quality gap scores
24. The hospital is easily accessible (e.g. parking facilities)	- 0.85
20. Doctors and staff are always neat	- 1.08
10. Hospital staff is always willing to help patients	- 1.09
16. Doctors have a wide spectrum of knowledge and are competent	- 1.18
3. Patients should be treated with dignity and respect	- 1.36

Table 8: Regression model for the overall quality gaps in the three dimensions and overall quality perceptions

	B	Beta	t	p
Overall quality perceptions				
(Constant)	5.321		41.200	.000
1. Human aspect	.451	.563	4.480	.000
2. Physical environment and infrastructure	.100	.117	1.054	.294
3. Access	-.048	-.065	-.710	.479

Note: Dependent variable: overall question on quality perceptions

Table 9: Correlations between the computed quality gaps in the 3 resulted dimensions (factors)

	1	2	3
1. Human aspect (Factor 1)	1		
2. Physical environment and infrastructure (Factor 2)	.789**	1	
3. Access (Factor 3)	.667**	.536**	1

Note: ** (Pearson) Correlation is significant at the 0.01 level (2-tailed).

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Strategies for Quality Improvement and Increased Efficiency in Health Care Systems

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Abstract

Purpose

The purpose of the present study is to develop practical knowledge about the management of strategic improvement and increased effectiveness in health care systems

Design/methodology/approach

In the study, we use an interactive research design. This means that researchers and practitioners collaborate on the various issues of the research project (problem analysis, discussions of empirical material, analysis and writing). Four main sub-projects concentrating on studying management and improvement of health care systems has been used in order to compile the findings.

Findings

In the study, we develop nine questions that are essential. These questions embrace important aspects that organizations should work with in order to succeed with improvement initiatives: These are: 1. How do we create awareness of the need for change? 2. What results do we expect from the improvement work? 3. What resources do we need in order to succeed in the improvement work? 4. How and where do we start the improvement work? 5. How do we work with the logistics of health care from a patient perspective? 6. How can we increase our organizational learning? 7. How do we create long-term thinking and commitment? 8. How do we design IT systems which support new and better work procedures? 9. What do we need to cease doing in our work?

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Introduction

In Sweden, health and medical care is facing great challenges (Cederqvist et al 2005; Sachs, 2004). During the next decade, a change of generations in the labour market will be seen when the generation born in the 40s begin to go into retirement (see Olsson et al 2003). The increased amount of elderly people will probably result in a sharply increased need of health and medical care. At the same time, financial resources are not expected to appreciably increase. Other important challenges are developments in the medical technical field and citizens' expectations. The medical-technical field's development has a tremendous impact on the health and medical care profession and its development is truly difficult to predict. Of central concern is the response to these challenges. How health care *systems* deal and cope with such changes? There are numerous of examples were organizations have found successful ways to deal with their challenges creating a performance and efficiency outperforming other organizations (see e.g. OECD, 2004; Sorian, 2006; Collins et al, 2001; Greenhalgh et al 2004). What can be learnt from healthcare organizations that work methodical and intentional to link the islands of success to become a whole system of success – a transformation. From these organisations we have searched for patterns that could explain clues helping other trying to shape and transform their organization into a sustainable system for the future; that is, to create strategies for quality improvement and increased efficiency.

Method

The present study can be seen as an interactive research project. In such models, the researcher takes active part in the object of her study (see Nielsen and Svensson, 2006; Fishman, 1999). Interaction research aims to contribute both to practical issues, e.g. how to handle practical problems in relation to the management of change, and to the creation of scientifically acceptable knowledge. It has its roots in action research which in turn is based in social science (Collier, 1945). The psychologist Kurt Lewin, considered by many to be the father of action research, argued for a discipline whose main purpose was "to help the practitioner" (Lewin, 1946). Action research, as practiced in Scandinavian countries, is defined by Nielsen and Svensson (2006) "as a scientific method for making research. It underlines the connection between understanding and change, between theory and practice, and an active co-operation between researchers and the participants in the production of new knowledge" (www.aktionsforskning.net, cited in Svensson and Nielsen, 2006, p. 14).

The starting point for this project has been: 1) a literature study; 2) an empirical study of internationally well known health care systems (hereafter called the successful organizations); 3) a survey which explores improvement initiatives in Swedish health care and 4) a study which illuminates the health care leader's views on structural change as a strategy for efficiency and effectiveness and also illuminates the leader's logics of management for change. The work in the present article is based on the report Strategier för effektivisering (2007). Practitioners and co-authors from that report were, besides the authors of the present article, Michael Bergström, Lena Eckerström and Roger Molin. All from SALAR (Sveriges Kommuner och Landsting).

Based on the previously mentioned studies we developed an interactive research model in which practitioners from the health care system collaborated with the researcher. From this standpoint four idea seminars were conducted. At these

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seminars people from different hierarchical positions as well as different organizational and geographical locations were invited to participate. Based on the objectives of understanding the premises of transformational actions among managers, *meetings were designed to tease out all important aspects in order to leverages the Swedish healthcare system*. More on the method is written in (Olsson, Övretveit et al. 2003). From these workshops four pictures were created. Among these pictures we searched for commonalities and constructed a picture of the shared pattern between the different workshops.

Finally we consolidated the emerging picture to a number of questions framing the guiding concepts used by managers creating a whole systems approach to transformation. This has been done over a one year period processing outcomes both within the research group as well as testing our assumptions on different professional groups within the Swedish healthcare system. Thus, the results we are presenting may be seen as temporarily and speculative. We have used the previous studies freely in order to create an understanding what it takes to manage initiatives for improvement and increased efficiency in large scaled health care systems. Of course, we acknowledge the difficulties in undertaking this journey but still we believe that it is both important and possible to find better alternatives than today's strategies.

Results
A general assumption made in the present work is that health care organizations exist and operate under various conditions. This requires that strategies must flexible and their applications adapted to the individual organization's own history and conditions. Outgoing from this assumption, we have compiled a series of questions which leaders have found useful for their initiatives in quality improvement and increased efficiency. We emphasise, the importance to see these questions as a whole; together, we believe these questions make it possible to increase learning and create systems which can function in a knowledge-guided manner.

1. How do we create awareness of the need for change?
2. What results do we expect from the improvement work?
3. What resources do we need in order to succeed in the improvement work?
4. How and where do we start the improvement work?
5. How do we work with the logistics of health care from a patient perspective?
6. How can we increase our organizational learning?
7. How do we create long-term thinking and commitment?
8. How do we design IT systems which support new and better work procedures?
9. What do we need to cease doing in our work?

1. How do we create awareness of the need for change?
What are the driving forces behind improvements? Research on the management of innovations and change points out the importance that there is awareness among those working within the organization of the problems and challenges it is facing (Beer at al, 2000; Van de Ven et al 2000; Olsson, 2002). From this perspective, leadership has an important role when it comes to driving the process of change (Berwick, 1996). Leadership should be able to motivate those involved and respond to the question: Why should we change? If they are able to do that, it is easier to succeed. Who wants to work to improve something which is not perceived as an important problem that needs to be solved? Consequently, professional practitioners need to gain insight into

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the problems confronting health care. This concerns shedding light on several dimensions of information/data simultaneously: medical results, patient experiences, finances, etc (Kazandijan et al, 1999). The creation of organizational transparency is one of the few, general tools which make it possible for leaders to pay attention to what is happening in the daily work of health and patient care .

A recurring aspect in creating tensions for change, found in the studied organizations, is the story, or narrative. When the results and the desired direction of development are told in terms of an actual case, in a story or in a relevant description, this captures the interest of those who work within these professions. The story is a way of clearly making a connection to the everyday reality where the results of health care are created.

2. What results do we expect from the improvement work?

Leadership has an important role to play when it comes to creating strategic expectations. Expectations do not emerge automatically. Research shows a clear pattern: Leadership has more impact if it has a clear understanding of what results can be expected, both long-term and short-term. The successful ones are signified for having a clear focus on improvement of the organization's combined performance. They want to simultaneously improve clinical and financial results, patient experiences, and personnel satisfaction within prioritized areas. Visions are important (Collins et al 2001). Since health and patient care organizations often are large and complex, there is a need to combine an often fragmented organization around a single vision. At the same time, it is desirable to avoid controlling every individual unit in the organization. Then the vision can function as a unifying bond and as an important communication tool which signals the organization's values and provides direction. We stress that the content of the vision is the final product of an interpersonal process; thus it is crucial that many people be involved when the vision is formulated. It is this process which creates a feeling of ownership and of wanting to live the vision, not relating to the paper on which it is written.

It is clear from research that leadership groups in successful organizations have developed their own core ideas which guide daily action and strategic decisions. The following guiding concepts repeatedly emerge as especially important (Transformera system; see also NATIONAL STRATEGI for kvalitetsudvikling i sundhedsvæsenet; ...og bedre skal det bli! Norska strategin for kvalitetsforbedring i sosial – og helsetjenesten)

- Patients are health care's most important customers, and goal-setting for our organization is to create value for and with them, as well as to strive for good health on equal terms in the general public.
- Health care is a knowledge-based service operation and its results are created in cooperation with the patient. Consequently it is an important, basic principle concerning increased effectiveness, to develop health care in close collaboration with the patients and attempt to understand their requirements, needs and thoughts.
- All of our results and the value of our organization are created in the daily operation where patients, professionals and support systems meet.
- Focus is on using feedback systems and performance measurements that are plausible for the professionals as well as helpful for the leadership, when

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discussing and understanding to which extent the organization is creating better value. The leadership needs to create arenas for this discussion.

The challenge lies in going from words to action, which is an important difference between leadership groups which pursue action-oriented transformation processes and those which devote themselves to comfortable, narcissistic operational development.

3. What resources do we need in order to succeed in the improvement work?

The work of increasing effectiveness itself demands resources. The leadership has an important role in producing the resources required in order to pursue a long-term development process (Van de Ven et al 2000). Studies of successful organizations show that their leadership makes necessary resources available op.cit, 2000). The process of change requires the allocation of time, money and support for competence development. The successful organizations point out that both current and future colleagues need to have competence in improvement knowledge (Batalden et al 2007). One consequence is, for example, that development of education in improvement knowledge at all levels and for all professions need to be strengthened (Universitetssamverkan för förbättringskunskap). In addition to this support, successful organizations have also invested in an infrastructure which increases the likelihood of attaining long-term, sustainable results. Besides training opportunities in quality improvement at basic and specialized levels, an environment for the leaders' continual learning, including support for the leadership group's learning, should be part of the infrastructure. Successful organizations also cooperate in research projects. They connect research resources in various knowledge centers, to the strategic transformation process. In this context, this concerns research which focuses on quality development, leadership/management, etc. This is done in order to create a foundation for knowledge-based leadership of the organization in the same way that diagnostics, treatment and nursing care should be knowledge- based.

4. How and where do we start the improvement work?

It is important that the leadership have a defined strategic intent about where the focus of the transformation process should be (Ovretveit, 2006). This is a conclusion that may be drawn from findings of local transformation processes. One way to choose strategic areas is to proceed from where the greatest value for the customers can be attained in relation to the organization's mission and goals. On a local level it is customary that a small number of individuals initiate a process of increasing effectiveness, since they themselves are interested in solving a specific problem. The problem with that type of minor improvement initiative on a local level is that it lacks strategic intent. The risk is that it is difficult to see the effects of these projects on the system level. In the long term, this may create problems for leaders higher up in the organization and can thereby threaten the long-term process. When strategic areas are prioritized, it is *necessary to balance between ideas which are based on professional motivating forces and the strategic needs of the organization*.

In order to handle this balancing, successful organizations have seen the usefulness of making organizational priorities. A strategy which helps to decide where to start is the Pareto principle: 80/20. It is crucial to identify the major patient flows, the major costs and/or costs for lack of quality, and make an evaluation of where the majority of the improvement potential is. Through discussions based on data, the leadership group

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can decide where it is suitable to begin the process of change. When the prioritization is made, the leadership group has solid ground on which to stand.

5. How do we work with the logistics of health care from a patient perspective?
Every operation functions through processes which create value for the patients, relatives and loved ones. In many cases these processes cross organizational boundaries. When the process of change is pursued with a focus on the logistics of patient care it may focus on actions such as:
- reducing delays and waiting times
- removing waste of resources from processes
- having a better flow • looking for bottlenecks
- standardizing where possible
- finding forms which shift resource allocation, tasks and responsibility from the line toward the patient's process through patient care

The activities which are carried out by the colleagues with support of their leadership need to be coordinated and, as needed, rearranged and transformed. The basis for which processes should be in focus is found through the Pareto Principle (80/20) (Deming, 1986). Performance measurements and patient information about medical decisions, activities and results are therefore fundamental information in this work. One type of distinction is between volume and complexity which requires totally different organizations. (see e.g. a discussion on complexity by Bar-Yam, 1996 and Bar-Yam 2006)

We know from experience that there is a variety of ways in which health care is carried out. It can be a matter of various degrees of standardization, depending on the extent of guidelines for diagnostic and therapeutic procedures, unexpected problems with patients or problems caused by factors which are related to the organization and the available personnel resources (Nolan ey al 1996; Horbrook et al 1985; Lindmark et al 2005). There are many ways in which to carry out health care. An identification of recurring patterns which represent the patient's path through nursing care will nonetheless provide a good ground on which to stand when working in a patient-oriented and task-directed manner. Working in a task-directed way entails placing the operation and its activities in the foreground. By making changes in everyday routines, changes in values and outlook are achieved. Research on successful organizations indicates that task-oriented approaches are the most effective, both as far as achieving actual results is concerned and in actively moving into a new way of thinking.

6. How can we increase our organizational learning?
Sixty to eighty percent of traditional improvement efforts whose aim is to transform the front-line work fail. This says something about how strong the forces are to preserve something in the status quo. This also says something about the need for special competence in order to carry out transformation. Unsuccessful improvement processes produce at least two negative consequences: one is a waste of economic investments, and the other being that the colleagues' trust in the process of change and in the leadership's new strategy is reduced. The latter being the most serious one, especially over the long term. This in its turn reduces people's willingness to become involved in future improvement efforts.

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Successful organizations have found strategies which minimize the effects of mistakes and make it easier to succeed. They start by testing, to a limited extent, how ideas can be adapted to a local context. This way of testing and adapting their ideas to local situations provides an opportunity to discover and learn how health care systems respond to change. This strategy also gives leaders the opportunity to slightly modify leadership control, since the risk involved is minimal. This method of working empowers the personnel and stimulates them to understand, and be happy about improving their own situation. While testing is taking place in local contexts, access is gained to improved results and new knowledge. At some point in the process the leadership must increase the extent of change in order to improve performance on the system level. When this point is reached, it is vital that the changes have been directed at the organization's strategic processes, for example that the choice of improvement areas in the organizations is based on strategic thinking about where the potential exists.

7. How do we create long-term thinking and commitment?

Entering into a strategic transformation process is a long-term undertaking. Upper management ought to ask itself how a sense of purpose can be maintained. Thorough changes often take many years to implement. Turnover of members and changed strategic directives create problems for the leader who wants to have a long-term involvement in this work. Leaders who have succeeded in attaining this sense of purpose work actively vis-à-vis the political leadership in order to align previously defined goals and aims with new ones. The professions are very important when changes in activities which contribute to results for patients are to be achieved. Then the starting point is the microsystem, which consists of the group which works nearest the patient together with the patient her-/himself, the technology being used (IT for example), along with the goals which have been set for patient care. The leaders' decisions and the strategic orientation which is implemented must be anchored in the microsystems, because it is there that patient care is actually formed. Leadership needs to find ways to support the microsystems in their development process.This is a matter of:

- setting up arenas where an understanding of what is important to implement can be created
- understanding the microsystems need for new support structures
- supporting a development-oriented process

Analysis and dialogue are important management tools. These are based on data which describe the results and the contents of the microsystem's everyday work. Involving both the microsystems and other surrounding systems is of vital importance when preparing and analyzing. This entails setting up arenas for comprehensive organization-wide strategic dialogues, as well as creating agreements among professions. For the inter-professional participation to take place, real support is needed. It is the task of leadership to create these arenas and provide frameworks and direction for them.

8. How do we design IT systems which support new and better work procedures?

The potential of information technology is put in its proper context when the starting point is that the value of the organization is created in the Microsystems (for a discussion on Microsystems see question seven). In the best cases, IT can be an integrated support for the work of the professions with the patients. From this

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perspective the development of systems is an operational issue rather than an IT issue. Developing IT systems which are not connected to the learning of the colleagues leads rather often both to new problems and to additional work. Successful organizations design their IT systems for capturing data, analysis, feedback of data and adequate support for decision-making. IT systems should support the patient processes. Therefore the systems should be able to communicate with each other. At the same time there should be online tools both for the daily and the strategic management of, and learning from, patient care. Systems which are an integrated aspect of patient care are now more frequently found in patients' homes.

9. What do we need to cease doing in our work?
A final question concerns activities which no longer create value and which the organization ought to stop doing. Often we continue to do things in the same old way, even though we have found a new way which is more effective. Then in practice the planned increase in effectiveness does not occur. When improvements in patient care do occur, it depends to a large extent on doing things in a new way. If it is made more difficult to fall back on old routines, it becomes easier to continue with the new efficient action. New structures can be linked to new behaviors in order to sustain what is new, which in turn is supportive for those involved. It is also important to discard equipment, methods, arenas, policies, directions, trainings, incentives and other structures which support undesirable behavior. Another aspect of this is of an internal resource nature. This is a matter of utilizing, from an improvement perspective, the defined strategic intents from the leadership regarding where focus should be. This makes it possible to communicate which other processes must be set aside, temporarily or for a longer period.

Summary and discussion
Results from successful organizations point unambiguously to a series of questions on which to focus and where solutions develop, which are adapted to the relevant context. The core is that all work to increase effectiveness must start from the perspective of the patient. The goal is to improve the clinical results at the same time as patients and citizens experience that patient care is improving. If this is not successful, the usefulness is dubious. From the perspective of leadership, measurements and follow-ups are therefore the basis for good results. Through measurement and support systems, the leadership creates a basis for measures, which make it possible to get the professions involved and bind together the various parts of the system. By having the colleagues trained in performing improvement work the valuecreating processes and systems are developed. The starting point in order to attain this is increased clarity about what the operational concept of patient care actually imply, i.e. answering the question of why we have a health care system. The value of patient care must be created in the everyday encounter among patients, professions and information technology. For a given health problem, the patient has contact with one or several value-creating entities which need to be coordinated in order to make an efficient whole that provides good care. Clarifying processes, resource allocation, tasks and responsibility is important.The task of leadership is to create arenas for dialogue, where knowledge based data from operations and the improvement process can be linked together with the intentions of leadership and the needs of the patients. The aim is to get the professions on board, which in itself to some extent entails a new philosophy for everyone. In order to clarify what processes are strategic to implement and within which areas, data and expertise are needed that

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indicate the potential and thereby help in arguing for the strategic choices which are made. The fact that there is new expertise from research does not automatically mean that it is put into practice. For that work, improvement knowledge and skills and support from leadership in the actual transformation process is required. Well thought-through strategies make it possible to know when an established development plan should be changed or left untouched. This is the key to creating long-term commitment. Within the leadership area there are several examples, tools and ways of thinking that are important aids. This base of expertise is not clearly known, trained and exercised by leaders and practitioners at various levels in the organization, which is also shown in international studies. The base of competence for leading and implementing strategies in increased effectiveness needs to be strengthened, both through traditional education/training as well as though action-learning and in new innovative collaboration arenas among county councils and universities. Working with a unified strategy is a long-term undertaking which requires resource allocation concerning time and competence development.

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Impact of Process Improvement on Patient Satisfaction in Public Health Care Facility in Pakistan

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Abstract: Quality of Service delivery in health sector is the most ignored area in Pakistan. Process inconsistencies generally have not been perceived as a major problem in public health facility in a typical developing country like Pakistan. The study will analyze the outcomes of process improvement in public health care facility resulting in achieving patient satisfaction. This study comprises of three sequential phases. First phase consists of identifying discrepancies between Quality of Services and its effects on Patient Satisfaction. Second phase will deal with understanding determinants of inconsistencies in health care system, particularly in terms of process performance. Finally a strategy will be evolved on the basis of research with a view to reduce process deficiencies and to evaluate existing inconsistencies.

Purpose: The main focus of study will be on the measurement of Clinical Quality Outcome of Public Health Care Facility. This research will suggest the mechanism to enhance hospital performance on selected indicators of Clinical Quality associated with quality improvement implementation in hospitals. A strategy will be adopted on basis of research to induce efficiency in processes and to assess overall improvement.

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Research Methodology: Data collection will be achieved through questionnaire, interviews (doctor, patient, paramedics and relatives of patient), field visits and observations. Survey will be conducted amongst patients, doctors, paramedical staff and concerned people. Quality will be measured on the basis of selected and defined Key Performance Indicators (KPIs) containing both process and outcome of the process. Some suggested KPIs may include but not limited to Acceptability, Accessibility, Appropriateness, Capacity, Continuity, Clinical Focus/Effectiveness, Efficiency, Patient Focus, Sustainability and Timeliness. Specific (Research) questionnaire will also be established to increase effectiveness of research.

Research Findings: Research will show relationship of the process improvement on the level of satisfaction of patient in Public Health Care Facility. Research will also indicate the impact of outcomes on the patient satisfaction but also sustainable growth of respective hospital. Study will also highlight core discrepancies in the Quality of health services in Pakistan and a strategy will be developed to minimize potential and present problem areas in the public health care facility.

Value of Paper: Utilization of health services is an important policy concern in most Developing Countries like Pakistan, reflecting both efforts to improve health outcomes and to meet international obligations to make health services broadly accessible. This research will help policy makers to devise effective health care operational plans for the overall betterment of hospital environment leading to society, country and humanity in a broader context.

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Impact of Process Improvement on Patient Satisfaction in Public Health Care Facility in Pakistan

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Abstract

Quality of Service delivery in health sector is one of the most ignored areas in Pakistan. Process inconsistencies generally have not been perceived as a major problem in public health facility in a developing country. This study will analyze the outcomes of process improvement in public health care facility in form of Patient Satisfaction. This research comprises of three sequential phases. First phase consists of identifying discrepancies between Quality of Services and its effects on Patient Satisfaction. Second phase will deal with understanding determinants of inconsistencies in health care system, particularly in terms of process performance. Finally a strategy will be evolved on the basis of research with a view to reduce process deficiencies and to evaluate existing inconsistencies.

1. Objective

The main focus of study will be on the measurement of Process Quality Outcome of a Public Health Care Facility. This research will suggest the mechanism to enhance hospital performance on the basis of selected indicators of Process Quality. Proposition will be given on the basis of research to stimulate overall improvement in delivery of health care service.

2. Scope

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This research is limited to patients and their attendants in public sector hospitals. Sample size consists of four hospitals, from twin cities (Rawalpindi and Islamabad). The study is conducted on patients of Emergency and Orthopedic department. The Study will focus on Structure and Process Indicators for instance, Acceptability, Accessibility, Patient Centeredness, Competence, Appropriateness, Timeliness and their effects on Patient Satisfaction. Other indicators of Structure, Process and Outcome are not part of this study.

3. Introduction

Adequate utilization of health services is an important policy concern in most Developing Countries like Pakistan. It reflects efforts to improve health outcomes and meet international standards to make health services broadly acceptable. This research will help policy makers to devise effective health care operational plans for the overall betterment of hospital environment leading to society, country and humanity in a broader context.

3.1 Patient Satisfaction

Not much work has been done to measure Patient Satisfaction in public sector hospitals of Pakistan. Patient Satisfaction is defined in terms of the degree to which the patient's expectations are fulfilled. It is an expression of the gap between the expected and perceived characteristics of a service (Lochoro, 2004). Measuring Patient Satisfaction depends on using the "accurate measures because it comprises of standards that incorporate dimensions of technical, interpersonal, social, and moral aspects of care" (Kane et al., 1997).

3.2 Donabedian Philosophy

This research is an attempt to formulate a conceptual framework by means of a categorization scheme. It encompasses selected indicators that can measure outcome in the form of Patient Satisfaction. Kelly and Hurst in *Health Care Quality Indicators Project Conceptual Framework Paper* states that One such method that is accepted globally is given by Donabedian which describes indicator as being structure, process or outcome in nature (Donabedian, 2003; Donabedian, 1980).

Structure indicators are based on healthcare system that constitutes of doctors and paramedic staff, training, equipment collectively. The health care system and the individuals in society and their interaction constitute Structure (van Driel et al., 2005).

Mere existence of Health care does not ensure appropriateness of processes and their outcome.

The non medical determinant of health care system which is measured under Structure is Physical Infrastructure that constitutes the environment and availability of spacious rooms.

Process indicators of quality refer to the things done to and for the patient by practitioners in the course of treatment. Process relates to interaction between the patient and health care provider (van Driel et al., 2005). Patient Satisfaction is the actual measure of clinical services that are being offered. The main interaction between Health Care System and Patients is measured by selecting following Key Process Indicators (Kelly et al., 2006)

3.2.1 Appropriateness: It is considered as performance dimension and relates to providing healthcare based on clinical needs. Appropriateness should be based on clinical evidence of the

effectiveness of the process concerned and 'consistent with current professional knowledge' (IOM, 2001).

Appropriateness comprises a series of dimensions essential for addressing the interpretation of performance as measured through indicators. Those dimensions include provider and patient expectations, local norms for the provision of medicine, ethical aspects and, most certainly, issues of social equity (Vahe et al., 2002)

3.2.2 Timeliness: It is the degree to which patients can receive care as quickly as possible and existence of such coordination where Patients are facilitated from one provider to another and different stages of procedures (Shortell, 1976). The clinical elements that are measured consist of time taken in laboratory diagnosis, duration in which X-rays are provided works, and waiting time for first response by hospital.

3.2.1 Acceptability: Kelley and Hurst identify Acceptability as conformity to the realistic wishes, desires and expectations of healthcare users and their families (Donabedian, 2003). It is measured from responses of Patients on their satisfaction level and extent of their understandability of medical procedures that are being offered.

3.2.3 Patient Centeredness: It refers to the partnership and relationship that is established among doctor patients and their families. Patient is considered the most central figure to the functioning of the health care system (Kelly, 2006). The indicator is measured in terms of doctor care and involvement about sharing their findings. It also incorporates Patients' views and suggestions.

3.2.3 Staff Competence: Competence constitutes the training and abilities of health care staff in term of technical and cultural aspects and their ability of communication with patients (Kelly, 2006).

There is considerable variation in perceived quality of care between various dimensions of modern health services, and between users and non-users (Baltussen et al., 2005).

Structure and Process have direct impact on outcome . Donabedian provide framework which connect Structure with process and process with outcome
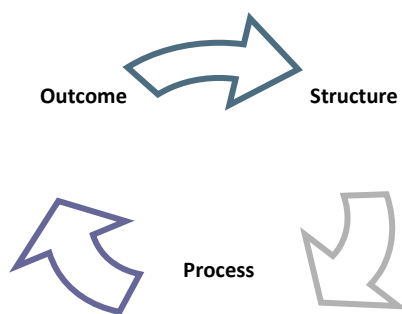
Figure 1.0: Representation of Donabedian Philosophy

In this research Outcome is determined in the form of Patient Satisfaction.

Level of Patient Satisfaction is determined by utilizing the selected indicators under the segregation of Structure, Process and Outcome, as given by Donabedian. Satisfaction is essential if we have to get people utilize services, comply with treatments and improve health services (Lochoro, 2004). On the basis of this literature Review conducted a three tier hypothetical model is conceptualized as given below

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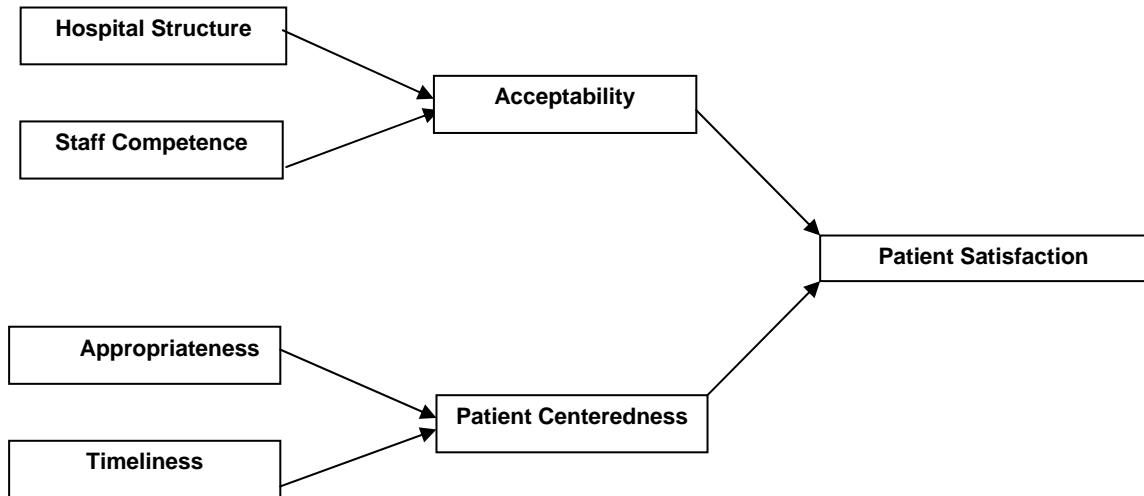
Figure 2.0: Pictorial Depiction of Hypothesized Three Tier Model on Patient Satisfaction

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5.0 Research Methodology

Initially 7 variables are selected for study. These variables are divided in to 3 tier structure model. In first tier affect of two independent variables are selected and their relation ship is studied with dependent variable. In second tier same procedure is adopted but variables are different .In third tier dependent variable of second and first tier are taken as independent variables while Patient Satisfaction is taken as dependent variable

5.0.1 First Tier Independent Variables
Hospital Structure and Staff Competence

5.0.2 First Tier Dependent Variables
Acceptability

5.0.3 Second Tier Independent Variables
Appropriateness and Timeliness

5.0.4 Second Tier dependent Variables
Patient Centeredness

5.0.3Third Tier Independent Variables
Patient Centeredness and Acceptability

5.0.3 Third Tier Dependent Variables
Patient Satisfaction

5.1 Hospital Structure and Acceptability among Patients

In an ideal scenario it is meeting or exceeding health care user's expectations. Acceptability is delineated as one of key dimension of Patient Satisfaction (Kelley et al., 2006). Research indicates that Structure assessment is done independently of process. Hypothetical model in figure 4.0 attempts to relate Structure with Acceptability. Proper structure will result in better medical care (Donabedian, 2005) .The assumption is made on basis of these studies that better structure will enhance acceptability among patients.

H1: Adequate Hospital Structure enhances Acceptability among patient

5.2 Competence of Hospital Staff and Acceptability among Patients

Competence refers to capability of hospital staff while interacting with patients. Competent health care personnel are assumed to improve effectiveness (Lochoro, 2004). This leads to postulation that competency will increase Acceptability among patients.

H2: Competence of Hospital Staff enhances Acceptability among patient

5.3 Appropriateness and Patient Centeredness

Appropriateness is defined as extent to which hospital health care facility are significant in satisfying needs of patients (Kelley et al., 2006). Studies reveal that if resources and services are properly distributed among patients it improves Patient Satisfaction. This research observes impact of Appropriateness on Patient Centeredness, as it is assumed that Appropriateness influence Patient Centeredness which in turn has an effect on Patient Satisfaction.

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H3: Process Appropriateness improves Patient Centeredness

5.4 Timeliness and Patient Centeredness

Timeliness is defined as an extent to which patients are receiving care without delay. Timeliness includes factors such as waiting times, time of admission etc. In many regions it is considered as closely coupled with patient centeredness (Kelley et al., 2006). Timeliness is considered to provide health care as need is recognized. Timeliness includes waiting time spent while waiting for doctor, waiting time at emergency, time spent for waiting laboratory test and their results. Delay makes patients and their attendant displeased (National Healthcare Quality Report. 2005). So it can be postulated:

H4: Timeliness Improves Patient Centeredness.

5.5 Acceptability among Patients and Patient Satisfaction

Acceptability is compliance to the rational requirements, requests and prospect of healthcare users (Donabedian, 2003). If a person is satisfied from current infrastructure of healthcare services chances of future utilization are more certain. Service oriented model are more adequate to patients (Berler et al., 2005).

H5: Acceptability among patient increase Patient Satisfaction

5.6 Patient Centeredness and Patient Satisfaction

Patient centeredness is considered as one of core quality dimensions. It proposes to place patient at center of health care delivery process. It is based on patient experience of care process (Kelley et al., 2006). It is defined as partnership between all stakeholders of health care system. It refers to individual preferences of an individual patient. It is assume to reduce misdiagnosis. Studies reveal that it helps to create balance in utilization of medical service. Patient Centeredness is assumed to decrease cost and cost of medical resources. But in some cases it is found to increase cost of provider. Soul of Patient Centeredness is communication. Communication make patient satisfied as he felt that attention is paid to him (National Healthcare Quality Report. 2005). Thus it can be assumed that patient centeredness can be associated with Patient Satisfaction.

H6: Patient centeredness increase Patient Satisfaction

5.7 Data Collection Method

Methodology adopted for conducting research is initiated with interviews of unstructured type. Unstructured interviews serve to highlight issues in service delivery process.
Patient Satisfaction surveys are designed to measure current level of Patient Satisfaction. These surveys include some selected KPI's like: Structure, Acceptability, Appropriateness, Patient Centeredness, Competence, Appropriateness, Timeliness and Patient Satisfaction.

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Results of survey will assist in analyzing current process status of health care delivery. It is also aimed at identifying discrepancies in quality of care framework. The result will be evaluated to improve services provided in hospitals of Pakistan

5.8 Data Collection

Overall 160 health care users participated in survey. Results of survey will be themes for unstructured surveys. Unstructured interviews are taken from 4 health care professionals. Data will be collected from four major public sector hospitals of Islamabad and Rawalpindi.

5.9 Limitation

Survey was conducted in emergency and orthopedic departments of public sector hospital only due to time constraints.

6.0 Finding and Analysis

Respondent reported to wide range of process KPI's addressing eight domains in survey. Three main regions of patient interaction are considered in every hospital. The most frequently mentioned areas are Timeliness, Drugs availability, waiting place conformability.

6.1 Affect of Hospital Structure and Competence of Hospital Staff on Acceptability

Suggested model was tested by using correlation. In first tier impact of patient perception of hospital Structure and Staff Competence is observed in reference with Acceptability. Correlation result of 0.6 show positive association between hospital Structure and Acceptability among patient.
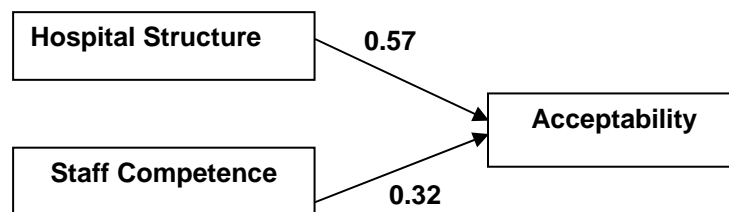
Figure 3.0: Correlations of First Tier

This in turn depicts Patient Satisfaction with current hospital infrastructure. Structure of hospital is measured on the basis of availability of medical health, building, cleanliness of room and availability of beds. Most of the results indicate positive relationship except availability of beds. Unavailability of bed indicates that hospital does not have enough resources to cope with growing demands of population. As limited space i.e. 16 beds were available in surgical wards of one of public sector hospitals. This results in delay of admission. Patient can only be provided with beds when beds are free. In some cases patients have to wait for months in order to get admission into hospital.

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Perceived competence of staff is measured with two parameters: knowledge of nurses, and competence of doctors. 0.32 indicates weak correlation between Competence and Acceptability. Even though patients are satisfied as far as current staff is concerned but their acceptability rates are low. This can be attributed to other factors like availability of proper resources

6.2 Relationship of Appropriateness and Timeliness with Patient Centeredness

In second phase of first tier Timeliness and appropriateness of process is measured in relation with patient centeredness.
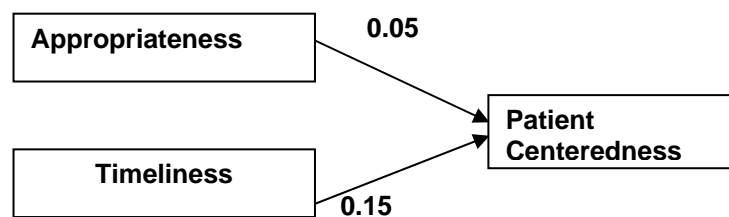
Figure 6.1: Correlations of Second Tier

Negligible correlation exists between Appropriateness and Patient Centeredness. This envisage in two alternatives. First option is to reject two hypotheses H3 and H4. But literature review given above opposes this alternative. Second option can be that less incompatible hospital process makes it less patient centered. Compatibility of process is measured through constructs like availability of lady doctor, waiting place facilities and satisfaction with doctor prescription. Waiting place is identified as main problem area. Examination of waiting area shows problems regarding drinking water and availability of seats

One of most objectionable measure is Timeliness. Complaints associated with this KPI are: waiting time for laboratory test, X-rays, admission into hospital. Weak correlation of 0.15 between timeliness and Patient Centeredness shows that low level of Patient Centeredness can be delays in health delivery service.

6.3 Affect of Acceptability and Patient Centeredness on Patient Satisfaction

Third tier of hypothetical model shows correlation as give below
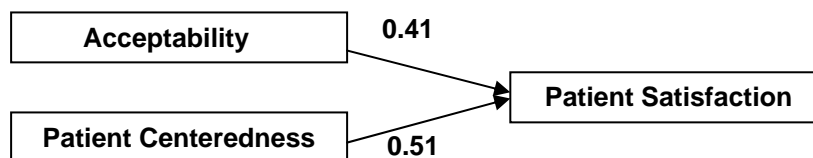
Figure 3.2: Correlation of Third Tier

Acceptability shows relatively weak relationship with Patient Satisfaction. This can be consequence of inadequate health care process which in turn has negative impact on patient satisfaction. This measure includes affordability, availability of resources, delivery of test results to patients, and explanation for reason for medical test. Another alternative is that patients are not capable of understanding test results and medical tests due to their low education level. Nearly 80% patients have no formal education level and only 15% have basic education. Assessment on basis of survey is not useful in this case. Observation base research may provide better result. Uneducated patients don't know about their rights and facilities they deserve from health care system.

All patients surveyed in general ward have income below $153 for month. Majority patients are from low income group nearly $61 per month for family of 5 to 8. In research response from this type of patients are vague. They are unable to identify problems. For them basic facility is to live. Some of surveys are rejected due to unawareness of patients.

Patient centeredness includes number of factors like availability of medicine in pharmacy, availability of time, getting attention of nurse and doctor listening skills.
Results were positive in this domain. Most of patients were happy with attitude of doctor, nurse and care provided by them. One of major complain in this area was unavailability of medicine at local pharmacy. Moderate relationship exists between patient centeredness and Patient Satisfaction. If medicines are available at local pharmacy result might be different. One basic problem identified in this area is unavailability of medicine at local pharmacy. Approximately 40 to 50 type of medicine are available at local pharmacy. All other medicine needs to be fetched from outside. In some cases medicine as minor as nausea syrup was unavailable. All other factors like attention by doctors and nurses, their attitudes, care provided by them shows positive results.

Affordability question is neglected as most of patients are treated free of cost. Public Sector Hospitals are relief for patients of lower income group who can not afford treatment on their own. Availability of grants for patients is again a cumbersome procedure which require a lot of time and in some cases patients do not live to the acceptance of grants.
Amalgamated view correlation along with problems areas are specified in form of figure:

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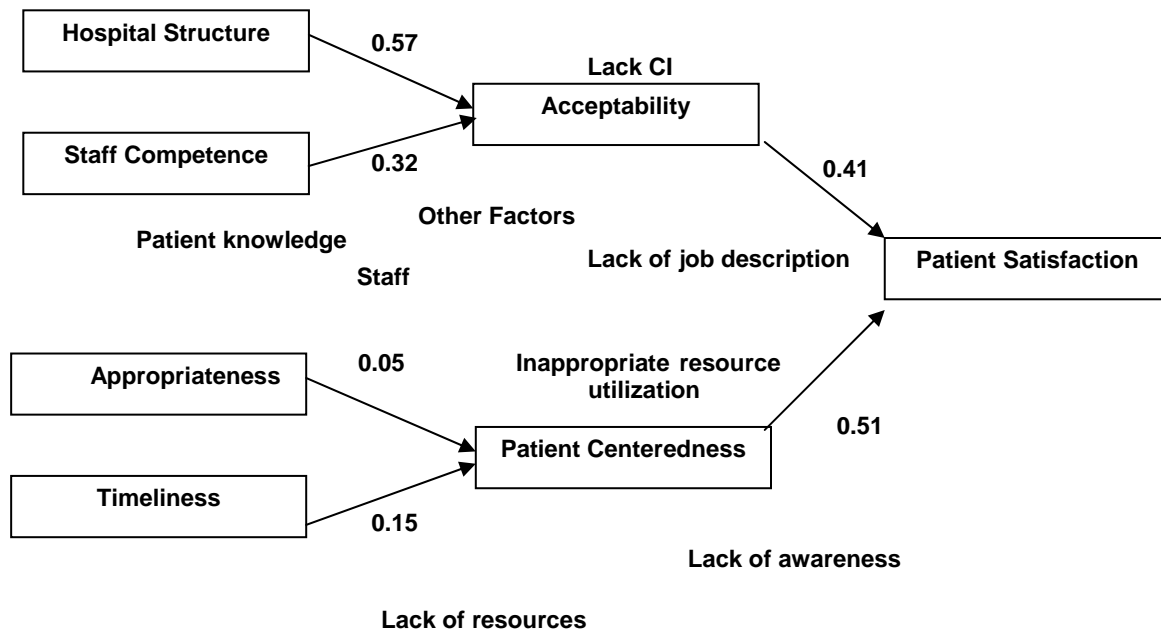
Figure 3.3: Cumulative Correlation along with Discrepancies

Conclusion

In many developing countries where basic necessity is to live, people often forget about quality of services. Identical behavior is observed in health care system. They are providing necessities required by patient. No arrangement is made to cater increasing demands of population. Public sector hospitals have resources but they are not managed appropriately. Doctors and paramedics have no knowledge about their job specification. Majority of patients i.e. nearly 80% surveyed are uneducated. Research in this type of environment should be observatory rather than survey based.

Management style should be participatory where all stakeholders like doctors, practitioners, paramedics, administration, patients and their attendants should be given chance to express their point of view. Departments of hospitals should be semiautonomous so they are able to make decision on their own.

This research shows that better structure of hospitals optimistically influence quality of health delivery process. Service characteristics effecting patient's perception of quality should be included while designing service. Majority of patients in public sectors hospitals are from lower income groups, service characteristics should be targeted toward lower income rather than elites. Hypothetical model given in research paper should be prepared by hospital to check index of customer satisfaction. Similarly financial infrastructure should be studied and linked with Patient Satisfaction index. Comparative analysis of all public sector hospitals of locality or country will be helpful. It will introduce healthy competition which will aim toward betterment of humanity in form of improvement in patient Satisfaction Index.

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Appendix

Correlation

	Struct	Accep	Access	PatCent	Comp	Approp	TL	Psat
Struct	1.00							
Acceptability	0.67	1.00						
Accessibly	0.43	0.26	1.00					
Pat Centered	0.67	0.69	0.32	1.00				
Competence	0.48	0.41	0.37	0.35	1.00			
Appropriateness	0.06	0.13	0.18	0.00	0.20	1.00		
Timeliness	0.24	0.45	-0.16	0.17	0.37	0.05	1.00	
Pat Satisfaction	0.20	0.16	0.28	0.23	0.21	0.44	0.01	1.00

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Exoticness, High-performance, and Luxury:
Design of a brand-specific supercar interior
using the PPE framework

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Abstract

Purpose: This paper presents a design study undertaken to develop a concept motorcar interior based on the Hulme F1 supercar exterior prototype. The study focused on generating an appropriate visual design proposal with the support of the Perceptual Product Experience (PPE) framework to guide design progress and validate design work.

Methodology/approach: Throughout the project, the PPE framework was used as a tool to specify, direct and evaluate design work and to support design decision making. Design research work was categorised in the stages of contextual research, contemporary design analysis, design development, and design evaluation. Evaluation was done using a small quantitative-qualitative survey with external respondents, employing VAS scales, Likert scales and open ended questions.

Findings: This paper illustrates how the PPE framework can be applied as an effective tool for establishing an appropriately and creatively managed design direction during the design development process. Providing a number of benefits for design research, the framework helps position, benchmark and develop visual design characteristics within a contemporary market context. The framework also supports the development of appropriate, valid and measurable experience design criteria, which traditionally is difficult due to the subjective nature of design perception. The outcome of the external evaluation indicated that intended experiential design criteria had successfully been transformed as perceived by the respondent group.

Originality/value: The structure and tools of the PPE framework to analyse, categorise, specify, direct and evaluate creative design work in an area where design work traditionally relies on intuitive and subjective approaches. This is of value for communicating, managing and direction design work on operational and strategic levels of design, and has the potential to contribute to the quality assurance of design processes.

Keywords: Perceptual product experience, PPE framework, automobile design, interior design, method, evaluation, design project

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Paper category: Research paper
Introduction

The importance of design to create pleasurable product experiences is well known. For example, Givechi and Velasquez (2004) showed that product design is capable of eliciting positive reactions such as joy, inspiration and achievement. Mano and Oliver (1993, p. 451) emphasized the interrelationship between product satisfaction and product-elicited emotions, acknowledging the importance of the subjective, experiential response for product satisfaction. They report that the dimension of 'hedonic' or 'aesthetic' performance, which includes the valuation of products for their intrinsically pleasing properties, is one of the two major dimensions of product relevance; the other being the notion of instrumental or utilitarian performance.

Authors in a number of fields, from psychology (e.g. Norman, 2004) to design have offered a variety of viewpoints which provide insights into the complex nature of product experience and its relation to, e.g., meaning (Vihma, 1995; Monö, 1997), formal aesthetics (Muller, 2001; Warell, 2001), emotions (Desmet, 2002), and brand specific product design (Karjalainen and Warell, 2006). Seva et al. (2007) found that affect created by product design strongly influence purchase decision. Kansei Engineering represents yet another approach to capture the emotional experience of product design. Clearly, desirable experiences are created through a range of aspects related to the experience of the product.

While approaches reported in literature tend to focus on the analysis and evaluation of product experience, the real problem for design often lies in the specification and generation of concepts that create intended experiences as perceived by users. The act of designing products with an appropriate, desirable and meaningful visual appearance is often a difficult and arduous task. Due to the often ill-defined nature of design, designers often experience difficulties with respect to knowing how customers perceive, 'read', the product; designing for specific experiences; and prioritising between desired experiences. The predominately intuitive and subjectively oriented processes of designers offer limited communicable rationale in terms of motivating and externalizing design decisions. The difficulty to objectively and transparently communicate design criteria and present rationale for decision making makes justification and validation of visual design an inherently difficult activity.

In this paper, an approach for design work that facilitates the above issues is presented and exemplified through application in a conceptual motorcar interior design project. Based on the structure and tools offered by the PPE framework (Warell, 2008b), the approach offers direction and support for establishing visual design decision making, and for assessing a design against existing designs, criteria and themes.

The Framework of Perceptual Product Experience (PPE framework)
Treating perceptual experiences involving any or all senses, the PPE framework (Warell 2008a, 2008b, Wang 2008, Young 2008, Warell 2007, Warell et *al.* 2006, Warell 2006, Warell 2005) offers a comprehensive and analytical structure for understanding product perception. Product experience is subjective and specific to each perceiver, and depends

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on personal factors (experiences, background, cultural values and motives), product related factors (type of product, properties and characteristics, brand), and external factors (environmental, social and economic context).

The framework considers perceptual product experience as composed of three core modes; the sensorial, the cognitive, and the affective modes of experience, and two dimensions; the dimension of presentation and representation (See Figure 1). In the following sections, the modes and dimensions of the PPE framework are briefly described (for more detail, see Warell, 2008b).
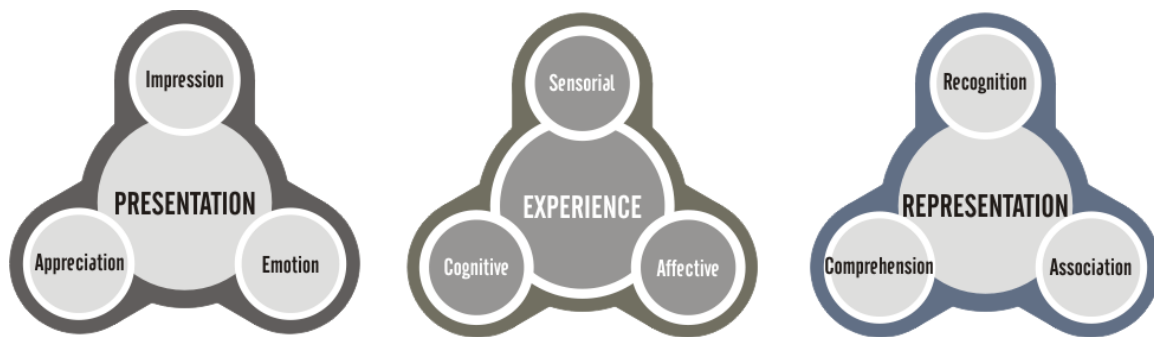
Figure 1. Framework of perceptual product experience (PPE framework), with core modes (centre) and the two dimensions of presentation (left) and representation (right) with submodes.

The three core modalities recognise all possible types of perceptual experience; including initial impression and recognition of product existence and specific perceptual characteristics (the sensorial mode); making sense of the product, its manifestation, structure, use, origin and purpose (the cognitive mode); and the affective response, attribution of value to, and judgement of the product (the affective mode).

The *sensorial mode* includes perceptions of stimuli experienced with any of the senses; vision, hearing, smell/taste, touch, or balance (Mather, 2006). Physiologically, vision can be regarded as the most highly prioritised sense. Sensory perception of the product leads to a range of experiences, including aesthetic, emotional (see, e.g., Desmet 2002, Norman 2004) and pleasurable (see, e.g., Jordan 2000) experiences.

In the *cognitive mode*, we understand, organise, and interpret and make sense of what we perceive. The cognitive part of the product experience processes and categorises sensory input, stores, creates and retrieves information and knowledge from memory, and supports in decision making, judgement and inferences (see Reisberg, 1996).

The *affective mode* concerns itself with experiences that are affective in nature, i.e. the give rise to feelings, emotions, and mood states, based on product perceptions (see e.g. Crilly et al. 2004, Visser 2006, Schütte 2005). As the affective system is judgemental (Norman, 2002), the affective mode includes associations and notions that people

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attribute to products, such as brand associations based on personal beliefs, values and emotions (Abbot et *al.*, 2006).

Apart from the core modes, the PPE framework recognises that the experience has a dual nature; that is, that the experience can be presentational as well as representational, as suggested by Vihma (1995). This inherent duality of the experience is made explicit in the two *dimensions of presentation and representation*. In the PPE model, the two dimensions 'map' to the sensorial, cognitive and affective core modes such that each of these modes are manifested in the presentation as well as the representation dimension. Thus, each core mode has a 'pleasurable' as well as a 'meaningful' dimension.

The dimension of presentation is concerned with the direct, 'pure' sensual stimuli related side of the experience. In short, presentation may be seen as the 'pleasurable' side of the experience, related to the direct, non-interpretative experience, i.e. experiencing the product for 'what it is'. The experience submodes in the dimension of presentation are described in the following:

Impression is the essential and first part of the experience, which in turn can lead to any, or all, of the other experiences. In the PPE framework, impression is the purely sensorial experience of becoming aware of a product as a result of it being sufficiently 'different' to stand out, be noticed and attended to, referred to as 'active selectivity' by Arnheim (1970, p.20).

Appreciation is about recognition of aesthetic values. In the PPE framework, appreciation engages cognitive processing of what we perceive through our senses. Part of the appreciation is the composition and order of perceived stimuli (Muller, 2001). The pleasurable experience of visual composition of detail and unity in product design can be enhanced by the creation of coherence and resemblance between elements within each structural level of the visual composition, as well as between the hierarchical levels of holistic and atomistic structure of form (Warell, 2001).

Emotion is the affective response evoked by the combination of product stimuli, subjective concerns and an appraisal (Desmet, 2002). According to Visser (2006, p.7), emotion is involved in the control of activity and thus influences decision making (Tversky & Kahnemann, 1981).

The *dimension of representation* regards the product experience as a meaning-making phenomenon that can be described by the three submodes of 'recognition', 'comprehension', and 'association'. The process of meaning making is socio-culturally contextualised and can be seen from the perspective of the producer (e.g., the designer or company) and the perceiver (e.g., the customer or user). The experience submodes in the dimension of representation are described in the following:

Recognition is based on familiarity, resemblance or similarity, and requires previous precedents to compare with. Thus it is dependent on the existence of pre-established references stored in long term memory (Simon 1992, p.132; Solso, 1999, p.78). Recognition of product type and brand requires resemblance to other products through

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similar sensorial elements. In the visual domain, such elements are known as 'signifiers' (Warell et *al.* 2006), or 'design cues'.

Comprehension is about making 'sense of things', such that products are "understandable to their users" (Krippendorff, 2006, p.xv). Through comprehension, we understand characteristics such as level of quality and the nature of the product; the product describes its operation, expresses its properties, and exhorts certain types of action or even non-action; it informs and advises about itself. In comprehension, perceivable references in the product point towards the product itself, providing meaning related to the nature, behaviour, properties and essential characteristics of the product as such.

Association is about communication of, e.g., values, origin and heritage, and is dependent on subjective and socio-culturally conditioned processes of coding, which determine how we associate references with meaning through symbolic signs within target market groups with similar values and aspirations; interpretative communities (Chandler 1994). In association, meaning is created (encoded) and interpreted (decoded) from two perspectives; from the point of view of the manufacturer, who uses the product to convey strategic brand messages and build brand values (see, e.g., Karjalainen, 2004); and from the point of view of the customer or user, who communicates personal values and preferences through ownership or use of the product.

Design Study Outline
In the study presented in this paper, the focus was on the visually perceived aspects of the product experience. Thus, during initial research, development and evaluation, emphasis was placed on the exploration and design of visual elements to support the establishment and communication of visual design format, brand signifiers, product semantics and core brand values.

The aim of the design study was to develop an appropriate conceptual motorcar interior for the Hulme F1 Supercar (Figure 2). The Hulme F1 Supercar exterior concept was designed to express 'luxury', 'high-performance', 'exoticness'. As the Hulme F1 brand is still in the process of being developed, these expressions were considered the core values for the Hulme F1 brand for the purpose of this design research study. Furthermore, the exterior prototype was designed to provide visual references to contemporary Formula One race cars.

Figure 2. The Hulme F1 supercar exterior prototype (Autocar, 2005).

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The interior concept design work aimed at developing an appropriate visual aesthetic in context to the existing exterior. This included designing a pleasurable interior that provided appropriate references, connotations and expressions for a vehicle of this type. Emphasis was also placed on basic ergonomic and functional requirements of the interior workspace in order to support the practicality of the design.

Methods and Results

During the design process, a range of methods and tools were employed to develop and assess the concept interior. The design work was characterised by four distinct stages; contextual research, contemporary design analysis, design development, and evaluation. In the following sections, the purpose, approach and results of each stage are described. Emphasis is also placed on use of the PPE framework and associated tools employed for the stages of contemporary design analysis, design development and evaluation.

Contextual research

Purpose
The first stage of research focused on establishing a general understanding for the core values in relation to this study. Additionally, research into areas such as the exterior form language, driver ergonomics, appropriate technologies and materials and the functional requirements of the interior cabin was undertaken. Exploration into these areas was carried out in order to establish experience and performance criteria to appropriately direct and support the design development of the concept interior.

Approach
This stage focused primarily on secondary sources of literature. Visual examples were established through image boarding and the identification of key motifs or themes in order to explore and describe the established core values. Definitions for each motif were developed based on a variety of sources as well as a review of contemporary product design.

Results
Motifs representing the three core values were established according to the following.

The concept of luxury is highly subjective by nature, and dependent on personal preferences as well as socio-cultural values. Attributes associated with luxury included a high purchasing price, exquisite presentation and quality of materials and high levels of hedonic value. Size, scale and weight are also factors but vary depending on the nature of the product. The results of this analysis indicated that to imbue the concept interior with a 'visual' sense of luxury materiality, creating strong associations with the exterior and expressing comfort would be of great importance. From this research, the following definition for luxury was developed:

Luxury**:** *'Something expensive, desirable, and comfortable, that uses expensive or desirable materials and has a degree of meaningful familiarity (or association) with the user'.*

Similarly, the following definitions for the two remaining motifs were established:

High performance**:** *'A machine with great or above average capabilities, designed with an emphasis on utility and functionality for professional users'.*

Exotic**:** *'Unusual, attractive and rare, but comprehensible within its surrounding environment and/or design type'.*

Figure 3. Visual design analysis of Hulme F1 exterior design

The analysis of the exterior form language of the Hulme F1 Supercar highlighted a strong referencing of contemporary Formula One race cars as seen in Figure 3. Notably, similarities between the exterior and contemporary Formula One race cars focused on the overall silhouette and packaging characteristics. Design detailing on the Hulme F1 Supercar is markedly simple in comparison to the Formula One race cars.

Contemporary Design Analysis

Purpose
A general understanding for the motifs of luxury, high-performance and exoticness were established in the previous stage of research. However, their visual implications for the concept interior remained relatively undefined and therefore did not adequately define an appropriate visual design direction.

In order to deepen the understanding of these motifs and thus reduce the degree of 'fuzziness' surrounding the definition of an appropriate design direction for the interior concept, this stage focused on exploring specific motifs and creating valid criteria for aesthetic design decisions made for the concept interior. The results from this stage were used as a benchmark for the generation of design criteria for the concept interior.

Two categories of design criteria were developed for this study. Experience criteria focused on desired experiential and perceptual based design attributes for the concept interior. Performance criteria focused on the desired functional, ergonomic and technological qualities for the concept interior. Each criterion was given a priority rating in terms of importance. This rating system included required criteria and criteria with a high, moderate and low level of desirability.

In relation to the PPE framework (see Figure 1), the analysis of contemporary car design focussed on the modes of impression and appreciation of the presentation dimension. The analysis did not focus on the emotion mode, as the understanding and analysing the emotional response elicited by a product requires participatory surveys with a wide range of respondents and therefore was considered beyond the scope of this investigation.

Approach
This stage focused on the analysis of a range of contemporary motorcar exemplars which were considered to carry appropriate expressions of luxury, high-performance and exoticness in relation to this study. The interior and exterior design of each exemplar were analysed using the structure of the PPE framework. Analysis focused on identifying interior as well as interior-exterior related visual design elements. The Design Format Matrix tool (Warell, 2001) was used to map and identify these elements. Corresponding to the identified motifs, the analysis of exemplars was structured into the three categories of luxury, high-performance and exotic.

Luxury exemplars
A selection of four-door saloons (Bentley Flying Spur, Mercedes-Benz S-Class, and Audi RS4) was used as the exemplars for luxury. This category of cars is generally recognised

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for excellent ride comfort and spacious interior, making them an ideal package for expressing luxury. Consequently, these exemplars offer an ideal starting point for understanding luxury in context to contemporary motorcars.

High-performance exemplars
To broaden this study's understanding of high-performance motorcar aesthetics beyond the Formula One race car, this analysis focused on LeMans prototype race car exemplars (Bentley Speed 8 and Porsche RS Spyder). The LeMans 24 Hour racing series is considered one of the most prestigious classes of motor sport. LeMans prototype race cars share many similarities with the Hulme F1 supercar exterior. For example, they are both designed to accommodate two occupants and have similar packaging characteristics. As a result, these race cars were considered appropriate for furthering this study's knowledge into high-performance aesthetics.

Exotic exemplars
A selection of contemporary supercars (Bugatti Veyron, Ferrari Enzo and Pagani Zonda F) was considered ideal for understanding motorcar aesthetic motifs of exoticness. Their rarity, distinct aesthetics and exclusivity ensure clear exotic attributes.

Results
The visual experience of all exemplars was analysed with respect to the PPE modes of impression, appreciation, recognition, comprehension, and association. Figure 4 exemplifies the results of the PPE analysis conducted on a 'luxury' based exemplar, the 2006 Mercedes-Benz S-Class. The analysis revealed notable findings such as the repetitive use of form elements shared between the interior and exterior design. This was of interest since, despite the distinct differences in visual structure between the interior and exterior, the design of the interior and exterior shared many similar form elements. The results from this analysis gave strong indication that the interior concept could share similar aesthetic values to the exterior yet still be visually distinct.

The results from the analysis of the appreciation mode of the PPE framework were mapped using a Design Format analysis matrix (Figure 5). The design format analysis identified the following significant trends:

- Luxurious motor cars tend to have simple interior/exterior visual compositions and make frequent use of form element repetition.
- High-performance race cars typically have complex interior/exterior visual compositions and a minimal amount of form element repetition.
- The visual qualities of exotic supercars tend to exhibit a balance between expressions of high-performance and luxury. Thus, depending on the overall expression of the supercar, the visual composition and repetition of form elements will differ. For example, the Ferrari Enzo expresses a high level of high-performance and consequently has a higher degree of composition complexity and minimal level of form element repetition, while the Bugatti Veyron has sharply contrasting visual characteristics.

Furthermore, the results also indicated that differing features within the interior can exhibit distinct visual expressions. Functional features such as controls often afford high-performance orientated aesthetics with contrasting materials and complex visual compositions. In contrast, other functional features such as seating afford more luxurious expressions with curvaceous inviting forms, soft leather trim and simple compositions.
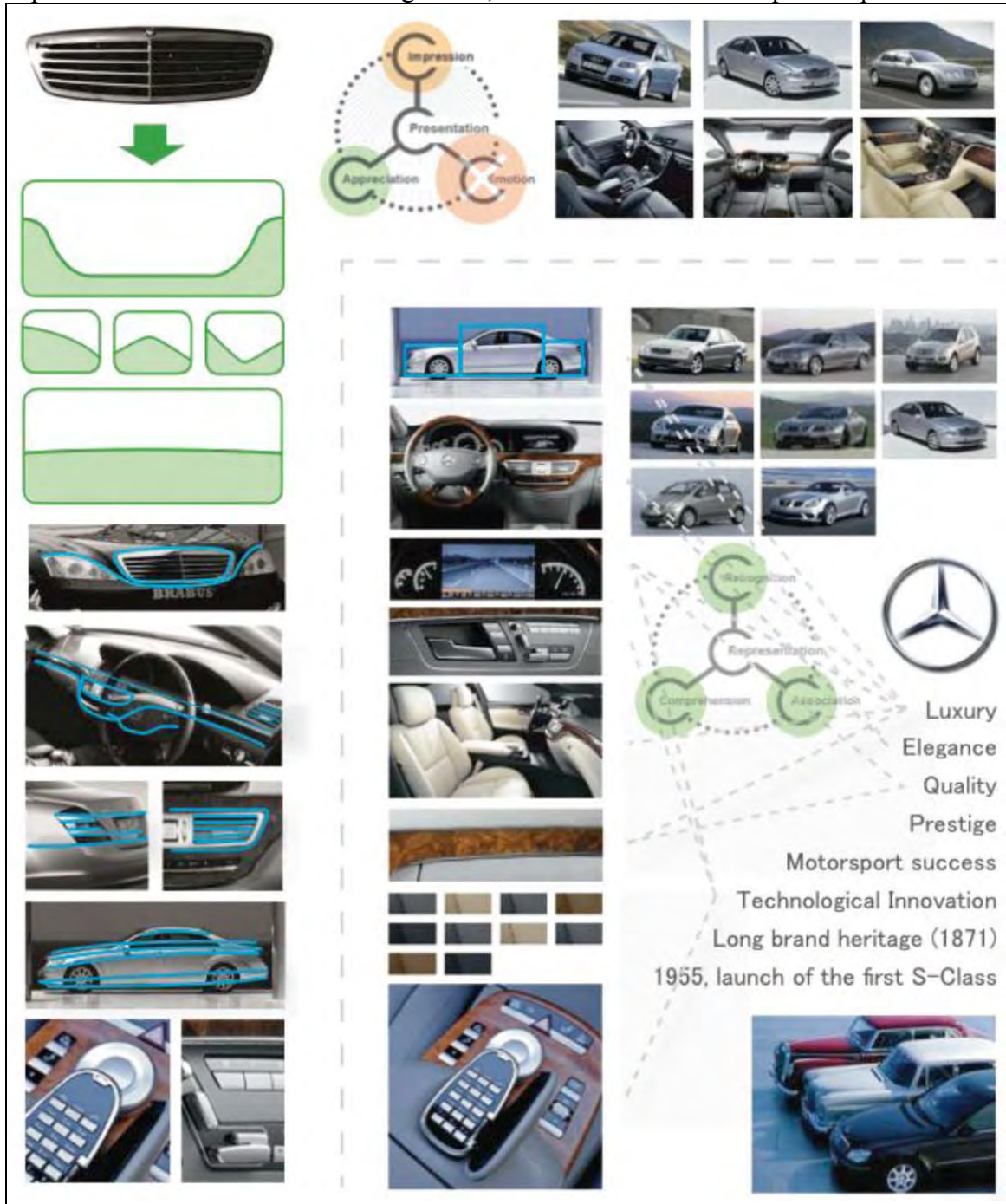
Figure 4. PPE analysis of the 2006 Mercedes-Benz S-Class.

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These trends along with the knowledge generated in the background research stage were used to generate experience and performance based design criteria. In total, 14 experience design criteria and 17 performance design criteria were developed.

Figure 5. Visual element analysis based on the Design Format method (Warell, 2001).

Design development

Purpose
This stage of research focused on design development of the concept interior.

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Approach
Creative practice was used as a research method to obtain new knowledge (Downton, 2003) and iteratively develop the concept motorcar interior. Commonly used design approaches were employed to generate the concept motorcar interior. These included concept sketching, rendering, form studies, basic ergonomic testing, elevation cross-section drawings, and the development of a half scale hard model.

In the design process, design criteria produced from the previous stages were utilised in order to appropriately direct the development of the concept interior. In terms of experience criteria, particular emphasis was placed on visual complexity and appropriate use of form elements in association to luxury, high-performance, exoticness, and contemporary Formula One race cars. To this end, concepts were constantly screened against the performance and experience design criteria.

With respect to performance criteria, ergonomic design focused on driver posture, vision, static and dynamic reach, control positioning, ingress, egress and accessible areas for storage of personal items. Testing employed two participants, a 95th percentile stature male and a 5th percentile stature female. In context to the scope of this study, these participants adequately represented a range of typical users for the concept interior.

Results
As this stage employed a variety of methods, a wide range of results were produced. These results were predominately expressed as visual design outputs. Initial concept work generated a wide range of proposals for the concept interior. These concepts were assessed against the experience and performance design criteria. Specific emphasis was placed on determining whether concepts fulfilled the 'required' and 'highly desirable' design criteria.

The final design (see Figure 6) focused on expressing appropriate levels of 'luxury', 'high-performance' and 'exoticness'. The expression of luxury was expressed through an overall simple visual cockpit aesthetic, soft-grain leather trim and form language which referenced the exterior surfaces. High-performance was expressed through visually complex detailing highlighting functional features such as the steering column, centre console and foot pedals.

Features from contemporary Formula One race cars were referenced within the design. Formula One race car cockpits inspired the sparse cocoon-like interior. The steering column drew inspiration from Formula One race car suspension arms (an example of the recognition mode of the PPE framework). This reference was considered appropriate for the steering column, as both relate to vehicle steering. Additionally, the grooves within the seat back, seat pan and foot wells relate to Formula One race car tyre tread (recognition). These references were also used as a means of eliciting exoticness (comprehension) due to their distinct semantic qualities.
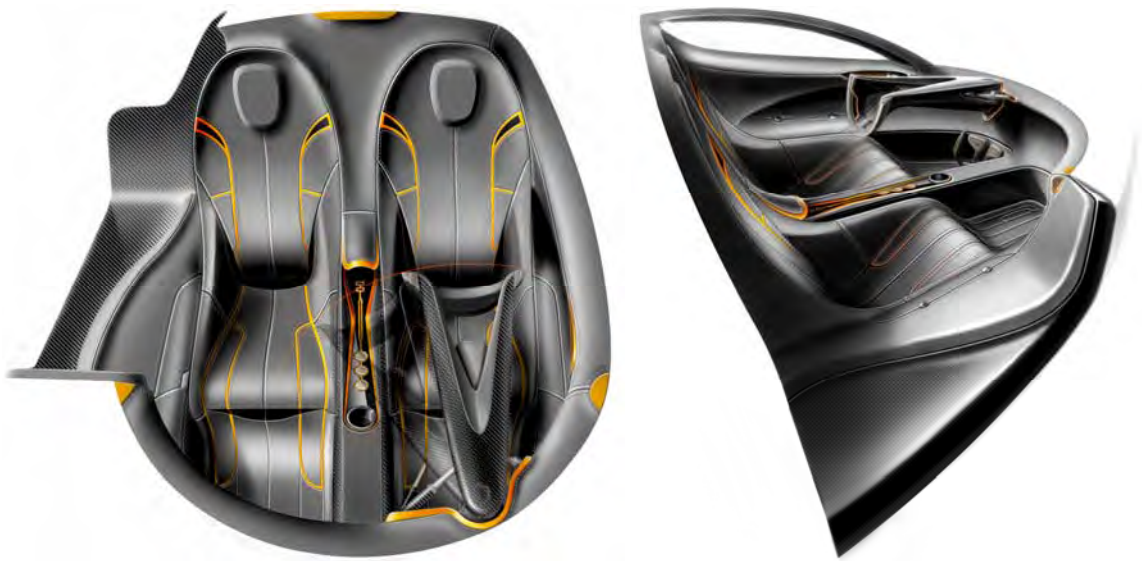
Figure 6. Final renderings of the Hulme F1 concept interior.

Other significant design features included:
- A steering column that pivots towards the centre of the cabin for greater entry/exit space.
- A hubless drive-by-wire steering wheel designed with a bevelled top edge to improve forward visibility.
- Longitudinally adjustable steering wheel and foot pedals cater for a range of users.
- Integrated occupant bucket seats with four-pointed safety harnesses.
- Vertically exposed and visually prominent foot wells.
- Passenger footrest designed to provide support from extreme breaking forces.
- Occupant sun visors have integrated touch OLED screens to access additional cabin controls and in-car entertainment.

Design Evaluation

Purpose
This stage focused on evaluating whether the concept interior successfully fulfilled the design criteria and aim of this design research work. Furthermore, the objective was to assess how the interior concept was perceived in relation to the desired key expressions of luxury, high-performance and exoticness. Assessment of the concept interior was considered to be significant in order to illustrate whether an appropriate (or inappropriate) design development process aided by the PPE framework was undertaken.

Approach
The design evaluation stage of the concept interior was divided into an internal and an external part. The internal evaluation focused on establishing whether the concept interior

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had fulfilled the established experience and performance design criteria. During the assessment process, the experience as well as performance based criteria were evaluated using a success or failure rating (see Figure 7).

Figure 7. An example of the internal evaluation of experience criteria of the concept interior.

The external evaluation employed a qualitative-quantitative questionnaire. In total, nine respondents participated in the evaluation. The respondent group, consisting of sales representatives for six premium and high performance car brands (Audi, Bentley, Ferrari, Lamborghini, Mercedes Benz, and Porsche), was chosen to represent a valid consumer group in terms of sensitivity and knowledge of exotic cars.

The evaluation questionnaire employed three evaluation techniques in a total of five questions. Visual analogue scales (see, e.g, Küller 1975, Gould et *al.* 2002, Schütte 2005) were used for subjective rating of visual product experience with respect to the degree respondents perceived the interior design to express the three core values luxury, exoticness and high performance (questions 1-3). For question 4, a five point Likert scale (see, e.g., Osgood et *al.* 1957) was used to rate the degree to which the interior design was perceived to complement the exterior design. For each question, an open ended response opportunity provided respondents to qualitatively explain their response. The questionnaire concluded with an opportunity to provide general comments regarding the interior concept.

The evaluation procedure was initiated with an introduction and the presentation of visual imagery of the interior design proposal. Questionnaires were then given to the participants. Participants were invited to answer questions 1 - 3 in reference to imagery of the interior design proposal. After question 3, participants were shown imagery of the existing exterior. Participants were then invited to answer question 4.

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Results

The results form the internal evaluation indicated that, in total, 47 out of the 49 established design criteria were successfully fulfilled. Of these, all experience criteria were fulfilled, while two of the performance criteria were not fulfilled by the design concept. Of the two considered unfulfilled, their exclusion can be summarised by the identification of unforeseen design issues making them inappropriate to achieve within the scope of the project.

The results from the external evaluation are illustrated in Figure 8. The mean VAS response for question 1 was 61%, indicating that the interior design proposal has a moderate level of perceived visual 'luxury'. Consequently, this result suggests that the interior design proposal successfully achieved its desired visual expression with regard to 'luxury'.

The mean VAS response for question 2 was 76%, suggesting that the interior design proposal had a high level of perceived visual 'high-performance'. This result validates earlier background research stating that the visual expression of the design proposal should have strong references to 'high-performance' but not be an actual 'high-performance' interior.

The mean VAS response for question 3 was 79%, indicating that the interior design proposal had a high level of perceived visual 'exoticness', suggesting the interior design proposal successfully achieved its desired visual expression in terms of 'exoticness'.

The mean response for question 4 was 4.6/5.0. This suggests that the interior design proposal is highly appropriate in relation to the existing exterior.

Discussion

The results from this study generated a range of insights. The PPE framework provided a highly effective structural approach to research, identify, map and define contemporary motorcar visual design motifs. These motifs proved to be an effective starting point for the discussion, generation and justification of experience based design criteria to support and direct the development the concept motorcar interior. Furthermore, the identification of these motifs illustrated the effectiveness of the PPE framework as a tool for building a visual design format within a contemporary market context.

Evaluating the interior design proposal against performance design criteria was a straight forward task due to the quantifiable nature of the established performance criteria. Despite their subjective nature, evaluating the experience criteria proved similar in ease to the performance criteria. Much of this is attributed to the use of the PPE framework, where its strong analytical structure underpinned much of the experience criteria. For example, the framework denotes the analysis of aesthetic characteristics through higher and lower order form elements. Analysing the interior design proposal for these higher and lower form elements made it simple to discern whether had a similar exterior form language characteristics to the existing exterior.

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Question:	How do you think this interior rates in terms of 'luxury'
1A	Not at all To a great extent $\overline{x} = 60.7\%$
1B	" Would like to see a greater level of 'plushness' " " Ultra contemporary " " Not luxury due to its hard edged look "

Question:	How do you think this interior rates in terms of 'high-performance'
2A	Not at all To a great extent $\overline{x} = 75.8\%$
2B	" Colours work well, seat design looks sporty " " Purposeful, non cluttered design. No frills. "

Question:	How do you think this interior rates in terms of 'exoticness'
3A	Not at all To a great extent $\overline{x} = 79.0\%$
3B	" Very unusual looking steering column " " Exotic interior ambiance " " Harness seat belts " " Steering wheel setup unusual "

Question:	How well does the interior concept compliment the exterior design?
4A	<table><tr><td>Tick-box rating assessment</td><td>High 5</td><td>4</td><td>3</td><td>2</td><td>Low 1</td></tr><tr><td>Participant responses</td><td>6</td><td>2</td><td>1</td><td>0</td><td>0</td></tr><tr><td>Mean response</td><td colspan="5">4.6 / 5.0</td></tr></table>
4B	" ...interior is a cockpit as expected. " " ...compatible DNA " " Same design cues, colour and shape "

Figure 8. Results from the external design evaluation.

The scope of this study did not allow for a statistically valid evaluation of the interior design proposal. Consequently, the results from this study were focused towards overall impressions of the design proposal. Due to the limitations of the questionnaire, there was no analytical means of discerning whether participant answers referred to formal aesthetic qualities, semantic qualities, or a combination of both, or what specific features they were referring to. The evaluation tools employed have been successfully used in previous PPE studies to evaluate participants' perception of products in relation to a range of PPE experience modes (see Warell 2008a, Wang 2008, Young 2008, Warell 2007, Warell et al. 2006). Although the sample group size for the questionnaire was limited, their expertise in the areas of luxury, high-performance and exoticness in context to motorcars indicate that the final design successfully embodied intended syntactic and semantic references, and provided intended experiences as perceived by users.

Conclusion

This paper illustrates how the PPE framework can be applied as an effective tool for establishing an appropriately and creatively managed design direction during the design development process. Providing a number of benefits for design research, the framework helps position, benchmark and develop visual design characteristics within a contemporary market context. The framework also supports the development of appropriate, valid and measurable experience design criteria, which traditionally is difficult due to the subjective nature of design perception.

The results from the external evaluation indicated that the PPE framework was useful as an effective tool for semantic and syntactic transfer; i.e. to convey intended expressions and achieve a pleasurable visual aesthetic, as perceived by external respondents representing the target consumer group. Expressions and appreciations of the concept motorcar interior as perceived by the expert respondent group were aligned with the intended PPE specifications as outlined by the experience design criteria.

Furthermore, this paper demonstrates that many of the theoretical aspects associated with the PPE framework can be transferred into design practice to elicit desired visual product expressions. The successful application of the PPE framework also illustrates its usefulness as a tool for integrating intended visual presentational and representational qualities such as appreciation, expression, and meaning within products in a validated way. The effectiveness of the framework and associated tools is illustrated in the way that criteria were established and used to direct ongoing design work, leading to an evaluated design outcome that was perceived and assessed according to desired key brand values and expressions. Implications for quality management and affective engineering includes the potential to use the framework as a tool to improve process quality in design management, and the use of the framework to support the design of Kansei Engineering studies, particularly with respect to identifying and categorising relevant experience aspects. This is of value for communicating, managing and direction design work on operational and strategic levels of design, and has the potential to contribute to quality assuring design processes.

Acknowledgements

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Kansei Engineering and Virtual Reality
in Conceptual Design

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Abstract:

Originality/value – The paper describes a conceptual design process focused on client emotions that integrates the Kansei methodology with virtual reality systems.

Purpose – The virtual reality techniques, kinds of human-computer interfaces, and how the analyses in virtual reality environment can improve the conceptual design of products are described. The application of Kansei methodology and virtual reality techniques to the conceptual design of a multi-task equipment is also analysed.

Methodology/approach – The followed approach consisted in three main phases: the use of Kansei methodology to identify the users emotional needs; the building of digital models through 3D CAD software; the evaluation of some prototypes by some users in the Virtual Reality laboratory of the "Dipartimento di Meccanica" of Palermo, in order to choose the best concept.

Findings – Kansei Engineering integrated with virtual reality turns out to be the technique that better satisfies the requirements of a collaborative and emotional design; in particular it may be used during the iterative phases of design and verification process, as it would allow to test the usability of various solutions in a very powerful, fast and easy way.

Keywords: Kansei engineering, conceptual design, virtual concepts, virtual reality evaluation.
Paper type: Research paper

1. Introduction

The recent trends in the field of design show an inclination towards solutions that try to provoke certain feelings to people. All this leads to fix the attention on a human ability impossible to automate: the emotion. With the aim of explain the emotional process and to design products so that they can cause certain emotions in customers, a field of research called Emotional Design has been created. The emotional design studies the complex emotional relationships that connect objects to individuals; these feelings can be of unconscious kind, since we often have difficulties rationalizing our feelings. To understand the emotional design various methods were developed over the years; one of the latest is the so-called Kansei Engineering, which was developed in Japan starting from the seventies; it is able to translate customers' impressions and requests on existing products or concepts into practical solutions design, responding also to the latent needs of customers. In this paper Kansei methodology is applied to collect information on various aspects of a product, and in particular to a multi-task equipment for academic use eligible to receive and store tools needed in teaching such as an overhead projector, a laptop, a projector and any accessories such as loudspeakers, trasparencies, lecture notes. The Kansei methodology has been used to gather information on various aspects of the product and thus be able to design some concepts through solid modelling software, thanks to the data collected during the course "Fundamentals of product design". The nine concepts that have obtained the highest score were compared in a collaborative meeting in the virtual reality laboratory of the department, finally choosing the best model.

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2. The Kansei Engineering and the conceptual design

2.1 User centred design and Kansei Engineering

Every industrial project is designed for humans; they interact with it through their physical-relational capacities, and the positive or negative outcome of the design process depends on the quality of this interaction. So it's necessary to implement an user centred project of the product. Consequently, it must take into account mainly the emotional needs of clients. In recent years areas of research, such as the Emotional Design, the Affective Design, Pleasure with products have been developed. These researches try to understand the users' personal impressions and make them describable, or at least measurable, to assess product solutions in accordance with emotional impact. The changing trends in users require new tools, integrating also emotional aspects in the development of the product. One of these tools is the Kansei Engineering; it is an engineering tool of great interest, since it is the only tool made specifically to quantify the emotional needs of users and to develop them into products. The term Kansei derives from two Japanese words, "Kan" and "Sei", which combined mean sensitivity or sensibility. According to the Japanese Society of Kansei Engineering, "Kansei is the integrated function of the mind and other functions that exist when receiving and sending signals. Filtering, acquiring information, estimating, recognizing, modelling, making relationship, producing, giving information, presenting, etc. are the contents of Kansei" (Schütte, 2005); then the Kansei is not only an internal process, but a process in constant contact with the outer world receiving information, processing it and reflecting it back to outer world.

2.2 Structure of Kansei Engineering

Although the procedure of Kansei Engineering seems to be heavily dependent from the context of individual research, there are many similarities in the procedures and instruments used for evaluation. Simon Schütte, of the Linköping University, has proposed a model of the structure of Kansei Engineering schematized in figure 1 (Schütte, 2005).
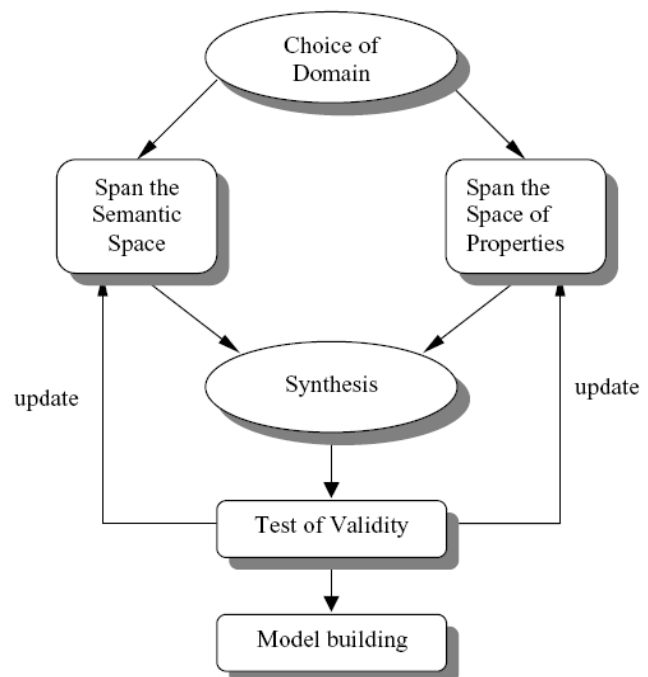
After choosing a domain, the idea behind a product can be described by:
- The semantic and
- The product properties

perspectives. Each of these descriptions explores a vector space; then these areas are analysed in relation to each others in the phase of synthesis. The data extracted during synthesis form input for the test of validity, which include various types of testing; through these results, the two vector spaces are updated and the stage of synthesis is carried out again. When the results of this iteration process are satisfactory, a model that describes how the semantic space and space of characteristics are associated can be defined.

Fig. 1. Scheme of the Kansei procedure.

Choise of domain

The domain refers to the type of product under study (Nagamachi). The domain may refer to existing products, to concept product, and to design innovative solutions. The definition of the domain also includes activities such as the definition of the target group and market segment on

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which to focus the investigation. To this purpose data series are gathered through market research and interviews with experts.

Spanning the semantic space

Osgood (1957) introduced the Semantic Differential Scales method to quantify the significance to give some ideas or some words. It was based on a semantic scale through which it was possible to determine whether and to what content a verbal description is a symbol for a particular object. The spanning of semantic space is divided into three parts. First it has collection of words that describe the domain, then the selection of words that have a higher impact on the customer and finally the choice of Kansei words; if important Kansei words are not considered, the result can become useless, then it is better to select a higher than the necessary number of words to the necessary. In order to collect all possible words connected with the product, the following sources are used:

- Magazines;
- Pertinent literature;
- Manuals;
- Experts;
- Experienced users;
- Ideas, visions.

The Kansei is expressed either by words in most cases, or by other grammatical expressions; it is very important to translate into Kansei also innovative ideas and concepts. Only in this way Kansei Engineering can be used as a tool of creative product development, generating new and revolutionary solutions.

Depending on the considered domain, the Kansei words generally vary from 50 to 600 (Nagamachi, 1997) and it is generally considered advantageous to use the original number of words to avoid loss of information.

The process of selection of words with the highest impact on the client is the target of the second step, which uses different methods, depending on the existing context.

These methods can be divided into two main categories:

- Manual Expert Methods (eg. Affinity Diagram, choices of designers, technical interviews)
- Statistical Methods (eg. Factor Analysis)

The words catalogued in semantic scales can successively represent the semantic space accurately; the result of the third step is a list containing the ranking of the words selected.

Spanning the space of product properties

The exploration of the space of product properties provides for a range of activities similar to those of the semantic space. Again the product properties are collected by employing various resources such as technical manuals, interviews with experts, literature, competitive products benchmarking. Using just these sources, however, it is difficult to develop innovative products; then all the imaginable properties that can enter in the domain must be looked, even those not yet present on the market. To prevent the Kansei interview become too burdensome for the interviewer, properties that users consider most important are selected.

Tools capable of achieving the selection are:

- Pareto diagram (Ferrigno et al., 2006)
- Kano Method (Ferrigno et al., 2006)

After these methods are applied, selected properties are grouped into sets of product properties from which representative characteristics of each group are chosen, which will be used in the next step, the synthesis.

Synthesis

In this phase interactions between semantic space and space of the product properties are analysed. The attempt to establish these connections is the heart of the work of Nagamachi in the recent years

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on Kansei Engineering. The main technique to make this connection is the supply of a questionnaire to users, in order to assess their preferences regarding the concepts of product selected.

Test of validity
At this stage the data coming from the synthesis are analyzed and if necessary iterated. For example, relatively to the semantic space it can be run a factorial analysis of data acquired by synthesis and comparing them with results issued from spanning of the semantic space; comparing these two results words that have no effect on Kansei can be identified. Then data are sent again to the semantic space and if it's necessary only one iteration, these new words will use to build the model. Theoretically, this procedure might be applied to space characteristics, but it has not been tested yet.

Model building
When the test of validity give satisfactory results, the data acquired through the synthesis can be presented in a relational model. This phase is probably the most important of the methodology, because it does Kansei an instrument capable not only to connect the Kansei words with the product properties, but also to quantify by objective criteria these reports. The construction of the relational model is carried out by different linear or non-linear mathematical applications; the kind of model depends on the context, because emotions and feelings do not follow already encoded mathematical laws.

Constructing Kansei Engineering questionnaires
In general it is important to build a questionnaire in a way that is less disturbing for data quality and allows the respondent to fill in as much of his/her own opinion as possible. The structure of the questionnaire depends on various factors, such as purpose, respondent group, available resources, but also the researchers personal style.
The figure 2 shows two types of questionnaire.

Fig. 2. Two types of questionnaires.

The type on the left shows a structure based on the Semantic scale, which is traditionally used in a Kansei survey; the concept of the product is indicated on top and evaluated according to different Kansei words. It allows rating the entities (products) separately according to the semantic dimensions spanned by the Kansei Engineering Words (KEW); the scale used for the assessment is 7 levels.
The example on the right is a modified version, which evaluates according to a Likert scale (Giordano, 2005); the Kansei word is on top and the products are rated below. This renders convenient to make a contemporary evaluation and a classification of products.
The questionnaire design can also greatly influence the response. For example rating the Kansei Engineering word "easy" before the word "precision" could result in a better rating for the second

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word than as if it was given separately or in context with other words. So it needs to look for the right arrangement of words to submit to users, so that there isn't positive or negative influence in the response.

3. Conceptual design of a multi-task equipment for academic use

The Kansei methodology to identify emotional needs of users has been applied in the conceptual design of a multi-task equipment for academic use, suitable to receive and safely store (against theft) a projector, an overhead projector, a notebook, loudspeakers, books, transparencies and whatever is necessary for teaching.

The approach also includes: the construction of models in CAD environment by Solid Edge software; the rating of some models in the virtual reality laboratory of the "Dipartimento di Meccanica" of Palermo to select the best concept. To the project realization 12 students in specialist degree of Mechanical Engineering of the course "Fundamentals of product design" have attended, which have been asked to express their opinion on the project through interviews and questionnaires.

The phases of design are schematized in figure 3:
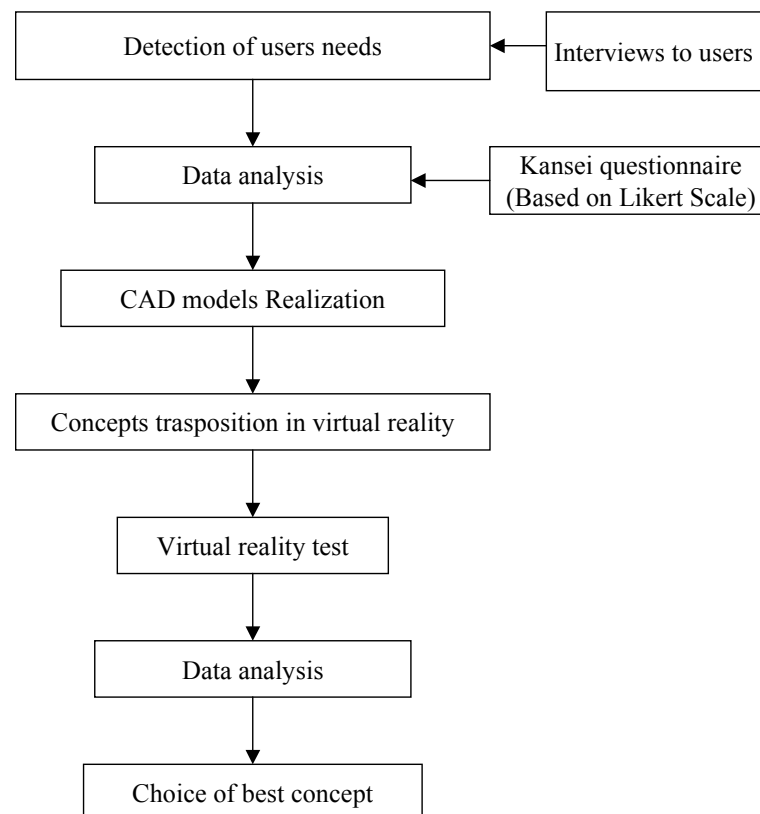
Fig. 3. Scheme of project methodological phases.

3.1 Users needs detection

The first phase consisted in a search for the Kansei words; to do that it was primarily chosen the domain within which to do the analysis. As interlocutors were chosen students of the course "Fundamentals of product design".

The next phase provides for the exploration of semantic space and exploration of the space of the product properties, by which one arrives at the synthesis stage. From an initial analysis some selection criteria, shown in fig. 4, were chosen:

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- Portability;
- Handling;
- Economy;
- Solidity;
- Aesthetics;
- Configuration variability;
- Easy connection to the network.
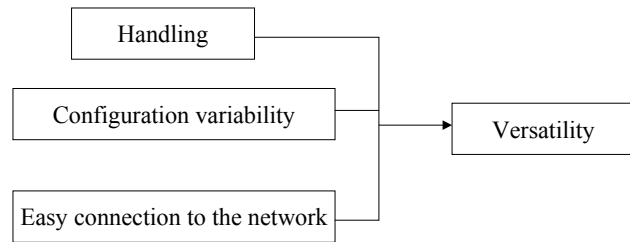
Fig. 4. Versatility scheme.

In a second step handling, configuration variability, easy connection to the network were grouped in the word versatility (see fig. 4).

Selection criteria	Total weights
Portability	15
Versatility	10
Economy	9
Small dimensions	10
Duration	10
Solidity	10
Constructive simplicity	8
Aesthetics	8
Use of recycled materials	10
Effective anti-theft system	10

Table I. Selection criteria weights.

The following needs regarding the space of product properties have emerged:
- Small dimensions;
- Duration;
- Constructive simplicity;
- Use of recycled materials;
- Effective anti-theft system.

The selection criteria were evaluated interviewing interlocutors, divided into groups, assigning weights to each word, by ensuring that the sum of the weights were 100. Weights equal to 15, 10, 8, 4 were chosen.

The table I shows the weights assigned to different selection criteria.

3.2 Kansei questionnaire

At a later stage has been constructed a Kansei questionnaire taking into consideration the words *portability* and *versatility* that better connect to product usability, incorporating the handling, the configuration variability, easy connection to the network and the ability to move the mobile more easily. The word versatility was combined with *aesthetics*.

Therefore it was decided to investigate:
- for versatility and aesthetics,
  opening systems choosing between two different opening systems for the upper and lower part of equipment and between types of external shelves;
- for portability,
  choosing between three types of wheels and three types of handles.

For versatility and aesthetics were chosen as factors: the shape, the material and the colour, each considered on three levels, so as to have 27 possible combinations, which correspond to an equal number of concepts.

For portability was considered only the combination of the three types of wheels (fixed, pivoting, spherical) with three types of handles (two simple handles, bar, two ergonomic handles), for a total of 9 combinations. The alternatives were considered on the basis of solutions already on the market and new solutions to try to innovate the product.

The table II shows the constructive solutions related to the versatility and aesthetics, based on type of structure, material and colour:

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Factors	Levels	Upper opening system	Lower opening system	External shelves
Type (A)	0	Folding panels	Drawer(s)	Sliding
	1	Shutter	Door	Sliding
	2	Door	Door	Folding
Material (B)	0	Plexiglas	Plexiglas	Aluminium
	1	Aluminium	Aluminium	Plexiglas
	2	Recycled plastic	Recycled plastic	Aluminium
Colour (C)	0	Dark grey	Dark grey	Dark grey
	1	Pale grey	Pale grey	Pale grey
	2	White	White	White

**Table II.** Constructive solutions.

The evaluation of the concepts was carried out using a Likert scale, with the possibility of giving a vote from 1 to 10 to constructive solutions, according to the Kansei word used.

For portability the best combination of the types of wheels and the types of handles was *ergonomic handles + spherical wheels* with a score of 8,75. From data analysis were selected for the versatility and aesthetics the nine constructive solutions with the highest scores (see table III):

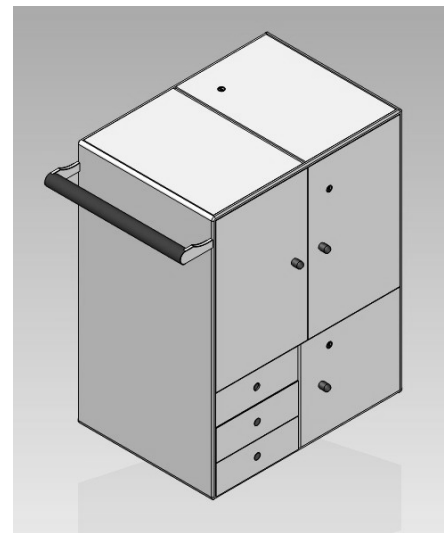| Concepts	A	B	C	Mean-scores
16	1	2	0	8
26	2	2	1	7,5
7	0	2	0	7,42
13	1	1	0	7,33
14	1	1	1	7,25
5	0	1	1	7,25
25	2	2	0	7,25
8	0	2	1	7,17
18	1	2	2	7

These nine concepts are based on three basic constructive solutions, which are extended by changing the materials and colour. Figures 5, 6 and 7 show the closed configuration of the three basic constructive solutions. The names were chosen by users groups.

Table III. Mean-scores of concepts.
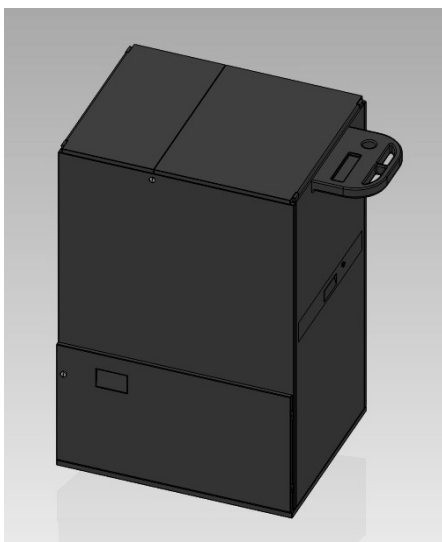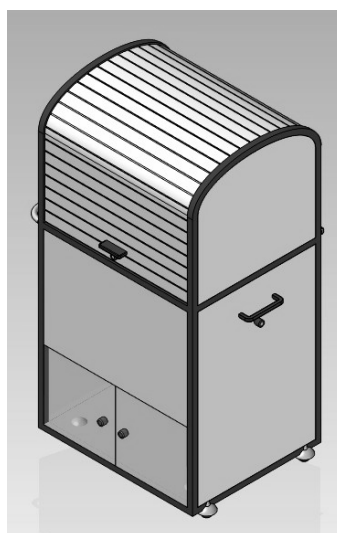
Fig. 5. Spider. **Fig. 6.** Multitask-compact. **Fig. 7.** Darma.

4. Implementation of Virtual Reality in the conceptual design

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The use of conventional CAD systems has been effective and profitable in the design process of new products; however it is largely confined in the last stages of planning. The traditional CAD systems are not capable of supporting the activities of the conceptual design, because we need for a more intuitive and natural way to consider the human-computer interaction.

A system of inputs for modern computers should be able to process 2D and 3D input signals; moreover the usage of CAD in the conceptual design should allow designers to concentrate more on the creative aspects of design, as well as on problems of interaction. The technology of virtual reality has emerged as an extension of 3D graphics performed by the last generation user-computer interfaces, which replicate a realistic functional environment through multiple sensory channels (vision, hearing, touch…). Virtual reality is seen as a very powerful tool in developing and implementing more natural and intuitive interfaces; it is generally recognised the need to integrate the technologies of virtual reality in the process of product development, especially in the conceptual stage, giving new contributions to the field of CAD. Technologies such as haptic interaction and stereoscopic display can help in the process of product design already in the early stages of design, combining with the assisted software design.

4.1 Concepts evaluation in virtual reality session

An evaluation of concepts by virtual reality was performed. In order to evaluate the 9 constructive solutions a questionnaire based on the Likert scale has been formulated, with a possible judgement from 1 to 10. The concepts were presented randomly. Table IV shows the concepts classified on the basis of final score:
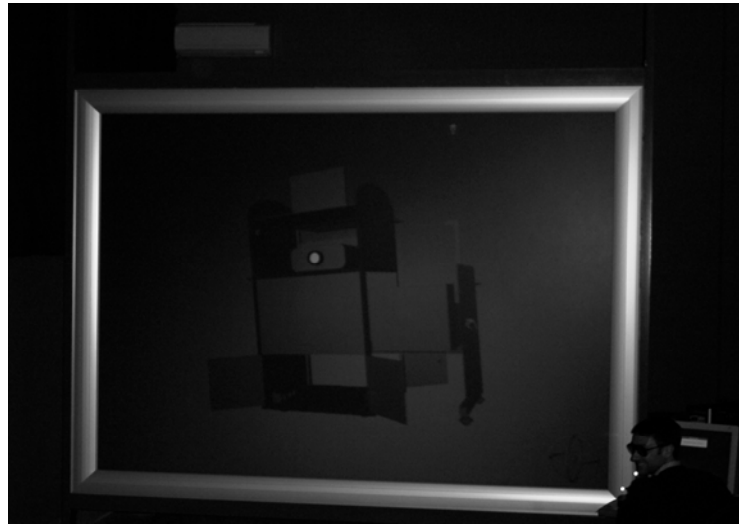
Order based on scores	Concepts	A	B	C	Mean-scores
1	5	0	1	1	7,75
2	26	2	2	1	7,75
3	14	1	1	1	7,67
4	13	1	1	0	7,58
5	18	1	2	2	7
6	16	1	2	0	6,92
7	8	0	2	1	6,58
8	25	2	2	0	6,58
9	7	0	2	0	6,5

Table IV. Concepts order based on scores.

On the basis of the results it has seen that two solutions have the same score of 7,75: the concept 5 and the concept 26. By majority vote the concept 26 was chosen. The solution doesn't coincide with that of the Kansei questionnaire (concept 16). To some extent, this highlights the important role that evaluation in a VR environment can play. However, the concept 16 and 26 were further compared. By majority vote has been chosen the concept 16 as the best.

This solution provides a multi-task compact type, with as upper opening system a shutter and doors as lower opening system; recycled plastic was chosen as material for opening systems, while aluminium for shelves; colour dark grey was chosen. To the concept were also added features relating to the portability that have been chosen by users in the Kansei questionnaire, that is ergonomic handles and spherical wheels.

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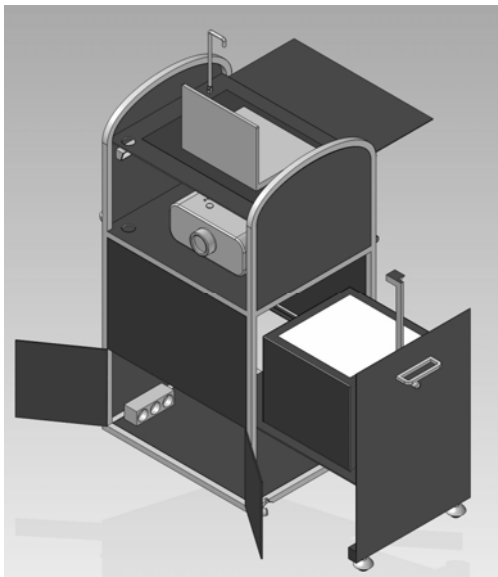Excellence; 20-22 August; 2008 in Helsingborg; Sweden

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The figure 10 and 11 show the final chosen concept from two different points of view:
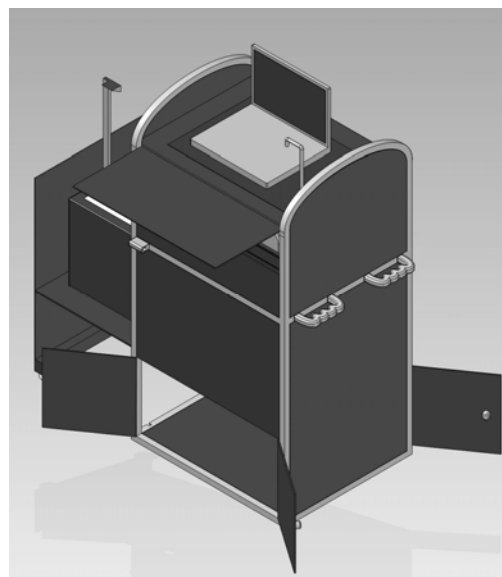

Fig. 9. Virtual Reality evaluating session.

Fig. 8. Virtual Reality evaluating session.

Fig. 10. Chosen concept (A1-B2-C0).   **Fig. 11.** Chosen concept (A1-B2-C0).

5. Conclusions

In this paper, in the light of recent developments in the field of design and considering the more and more larger diffusion of emotional design, it was performed a conceptual design process focused on client emotions. The procedure is characterized by the use of Kansei Engineering combined with virtual reality techniques to enable a quality improvement already in the stage of conceptual design of the product.

It was carried out the design of a multi-task equipment for academic use; it was decided to simplify the Kansei procedure so that users could answer in the best way the questions, without get bored, giving in this way the most reliable results. The concept based on the characteristics that had the highest score in the Kansei questionnaire was chosen. However a confirmation test was required, probably for the information lost due to the simplification of the procedure.

Certainly the virtual reality has helped the design; through VR users have been able to verify directly the solutions chosen by the questionnaire and then better to assess the best constructive solution. Kansei Engineering integrated with virtual reality is certainly the technique that better satisfies the requirements for an approach to participatory design; in particular it may be used during the iterative phases of design and verification process, as it would allow to test the usability of various solutions of the project improvement.

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Exploring Texture Pattern Features and Relations to Kansei with 2D FFT - Wallpapers and Dashboard Leather Grain Patterns

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Abstract

Purpose – Ablity of texture pattern recognition of human is very high and precise. Although details of texture significantly affect to Kansei, grasping texture features in quantitative methods have been difficult. We have analyzed wallpaper and car dashboard leather grain patterns with 2-dimensional FFT (Fast Fourier Transfer). Relations between spectrum features and Kansei evaluation are also analyzed.

Methodology/Approach – On Wallpaper study, sample rooms with various wall paper were made with architectural 3-dimensional CAD software. Twenty- five different wallpaper samples were used. Fifty-four Kansei word pairs were used as 5-point SD questionnaire. Sample pictures were presented with color calibrated display.

With PCA, we have analyzed Kansei space. The 1st principal component was named as "Activity". The 2nd pc was "refined-ness". Then we have analyzed texture of 3 samples with 2D FFT, those have almost same color but differs on texture.

On car dashboard leather grain patterns, 24 samples of different pattern those have same color were evaluated. Using close-up camera picture, leather grain patterns were analyzed with 2D FFT.

Findings – On wallpaper study, the samples 20,17 and 11 have almost same grayish beige color. On sample 20, 2D FFT result clearly shows the dominant pattern of check and its higher harmonic components. In sample 17, the result suggest the oblique components, In sample 11, there are wide renge surge of oblique components suggests various frequencies of triangular texture. Even within the triangles, as lower frequency components increase, "activity" decreases and tends toward "heavy" Kansei.

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On leather grain pattern study, variations of grain size, variations of grain shape, line directions and intensity were captured from 2D spectrum. Critical frequency features for Kansei were also found.

Originality/Value of paper – Modern pattern analytic techniques have been not utilized for Kansei engineering. We presented very useful and promising technique for quantificate various detailed features.

Keywords *texture analysis, 2-dimensional FFT, multivariate analysis*

Paper type *Research paper*

1. INTRODUCTION

In Kansei engineering, we have been treated design elements variations as categorical variables (nominal scale).   Typical coding are such like long / tall / short / cubic or round / square corners. Categorically coded design elements are assigned as Xs, Kansei evaluation value on a Kansei word is assigned as Y, then weights on Xs have been solved with Quantification Theory Type I, a variant of multiple regression analysis. This way of analysis is useful in the practical applications those have compounds of various types of design elements.

On the other hand, categorical coding loses the design details in the analysis. Many design elements can be expressed in analog continuous figures (interval scale) with proper measurement.

In this research, we have analyzed relations between texture patterns and Kansei. With the multivariate analysis based approach, we analyzed relations between wallpaper texture and Kansei evaluation. Then, frequency domain of the texture patterns was analyzed with 2-dimensional FFT (Fast Fourier Transfer). We have considered the aggregation with common multivariate analyses and pattern analysis technique to exploring relations between Kansei and design more in detail.

2. 2D FFT

There are several approaches for analyzing 2D patterns from the aspect of special frequency. We have analyzed these samples with 2D FFT. Two-dimensional FFT is used as a method of analyzing special frequency in a shape of spectrum. And in signal processing field, it has been used for frequency filtering method, especially for removing higher or lower frequency noises. To removing noises, calculate the picture's 2D FFT, then removing unwanted frequency region, finally by computing inverse 2D FFT, noises are removed. In this study, we have used 2D FFT as a spectrum analyzer of texture pattern and texture orientation.

Computation of 2D FFT has two stages. At first, each line (row) of original picture is substituted by its 1D FFT spectrum, and then 1D FFT is prerformed on each column [1]. At each row, when lower cycles have more power than higher cycles, then left side of the spectrum has higher value, on the result of "1st step: FFT on rows". In this research, all original samples have 255 x 255 pixel size, then lowest frequency is the 1 cycle (corresponds to 255 x 255 check) and the highest is 128 cycles (2 x 2 check) (shown in Figure 2). In the example which shown in figure 1, the zone from 1 cycle to around 50 cycles has higher power.

In the 2nd step, FFT was performed on each column on the array of row FFT results. Its outcome means analysis of the perturbation (on row) of each cycle (of row FFT).

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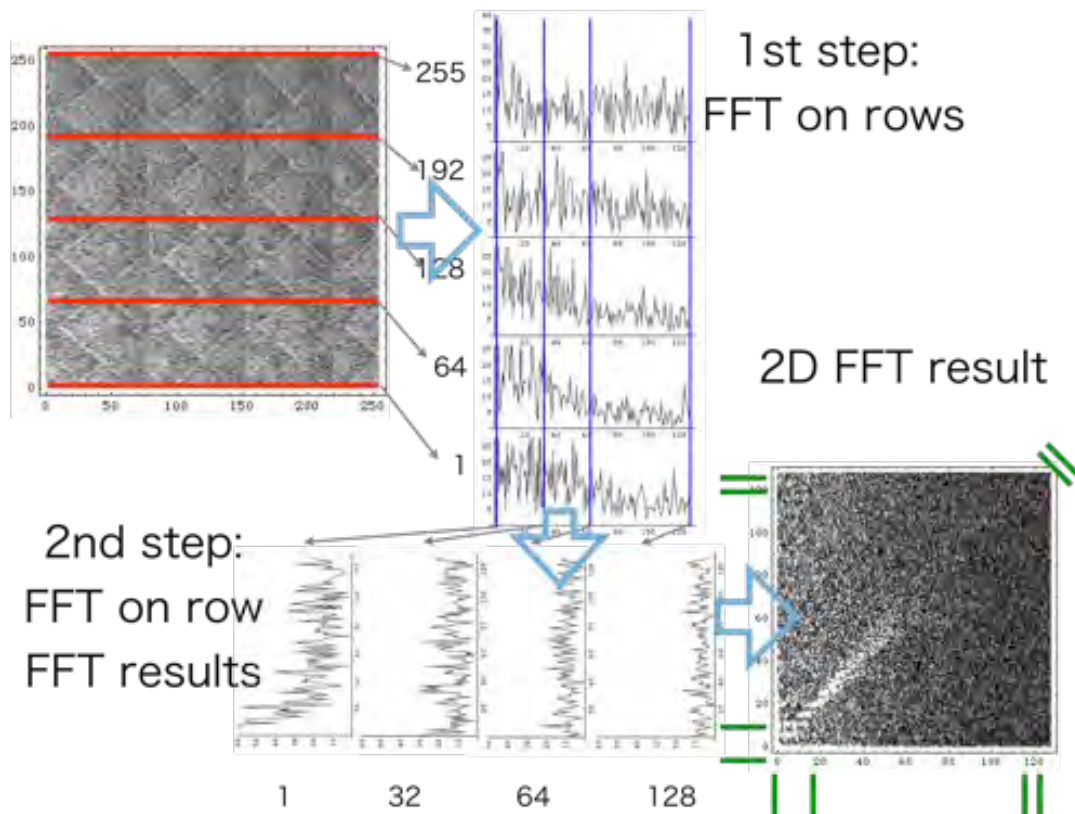Excellence; 20-22 August; 2008 in Helsingborg; Sweden
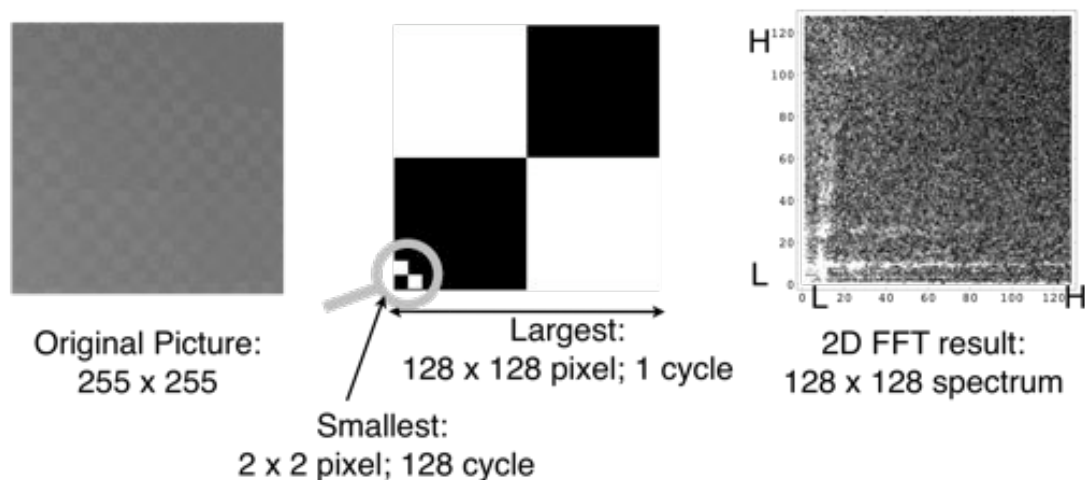
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Figure 1. Scheme of computing 2D FFT

Figure 2. Original picture and corresponding cycle

In the example of figure 1, 2nd step FFT at column 1 shows the perturbation of 1 cycle, the very row frequency. In common texture, low frequency component has low frequency perturbation. On 32 cycles, there are surges from about 22 to 38 cycles. These correspond 11 pixels (255/22) to around 7 pixels (255/38) texture pattern, parts of various frequency of fabric texture.

In a result of figure 1 example, diagonal surges are apparent in the 2D FFT result. These correspond to the various frequencies of oblique texture pattern. In figure 2, several horizontal and vertical surge lines correspond to one dark or light block, check, and their harmonics.

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3. KANSEI EVALUATION EXPERIMENT OF WALLPAPER

3.1 Evaluation Experiment

We have made 25 sample rooms with different wallpaper patterns with architectural 3-dimensional CAD software (Vectorworks ver.12). Twenty-five commercially-produced wallpaper samples were scanned and used for texture mapping on the wall.

Subjects were 10 males and 12 females, whose ages are between 20 to 23. Fifty-four Kansei word pairs were used as 5-point SD questionnaire. Sample pictures were presented in random order with color-calibrated display.

Figure 3. Evaluation sample

3.2 Kansei Analysis with PCA and QT1

With PCA, we have analyzed Kansei space. First and second principal components were considered because of the larger eigenvalues.

In the 1st principal component, "bright", "lively" and "childish" have larger positive loading, "dark", "adult" and "heavy" have larger negative loading. The 1st principal component was named as "Activity".

For the 1st phase analysis, relations between design elements were analyzed with Quantification Theory type I analysis (categorical coding of the texture). On the right hand side of figure 1 (upper graph), we found the relations such as, "bright" is picture pattern or check, "childish" and "feminine" are picture pattern. On the left side, "adult" is stripe and warm color, "masculine" is stripe.

In the 2nd principal component, "refined", "simple", "plain" and "decent" have larger positive loading. "Coarse", "unique" and "glitter" have larger negative loading. The 2nd PC was named as "refinedness". On the upper side of figure 4 (bottom graph), "Decent" is stripe and warm color, "refined" is stripe, "chic" is solid color. On the bottom side, "brilliant" and "individual" are picture pattern.

In general, "activity" positive words are check or picture pattern and in cold color. "Refinedness" positive words are plain or stripe. Moreover, many of them are in warm color.

Figure 5 shows the design suggestions based on above results. For "active" and "healthy" Kansei, cold color and check paper is appropriate. For "ease" room, warm color and stripe paper is preferable. For "chic" room, warm color but plain, unpatterned paper is desirable.

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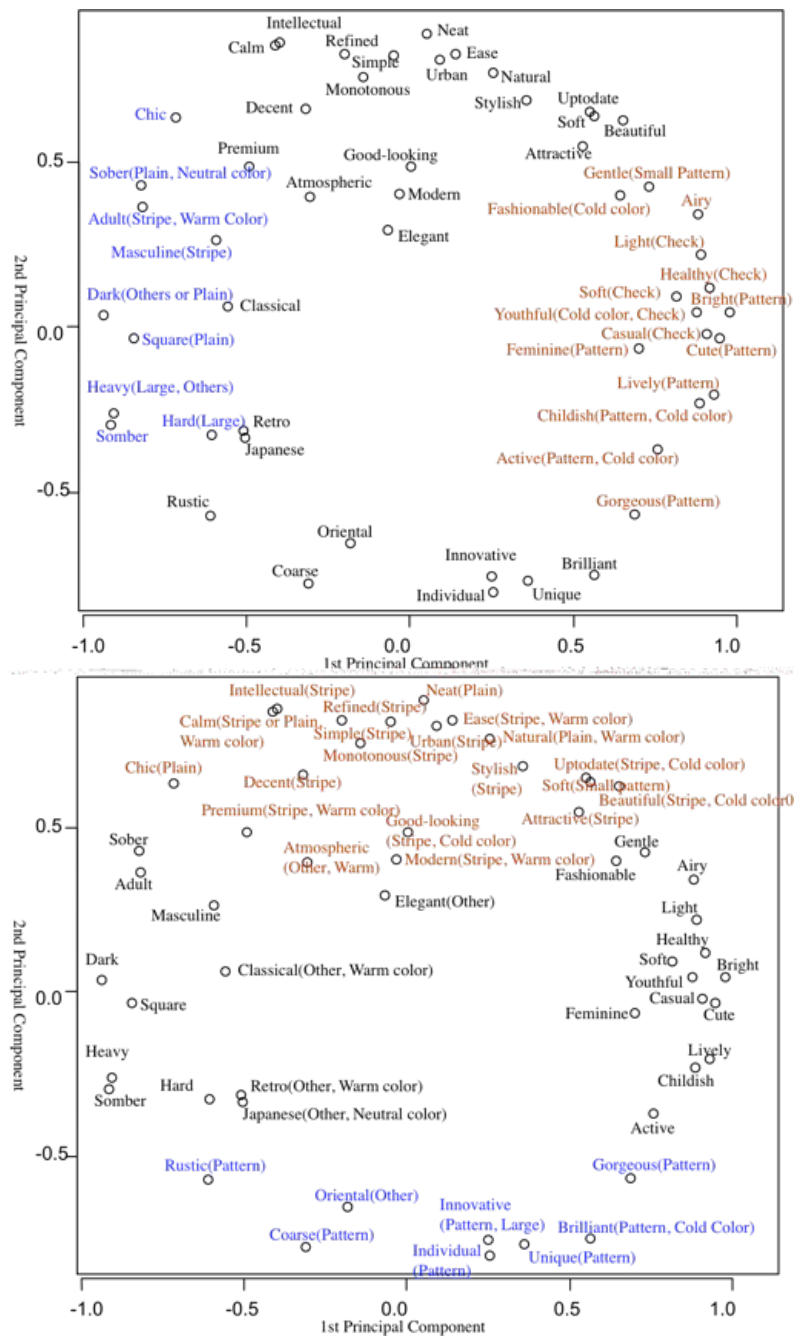Excellence; 20-22 August; 2008 in Helsingborg; Sweden

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Figure 4. Principal component loadings of Kansei words and corresponding design features (upper: along 1st PC, bottom: along 2nd PC)

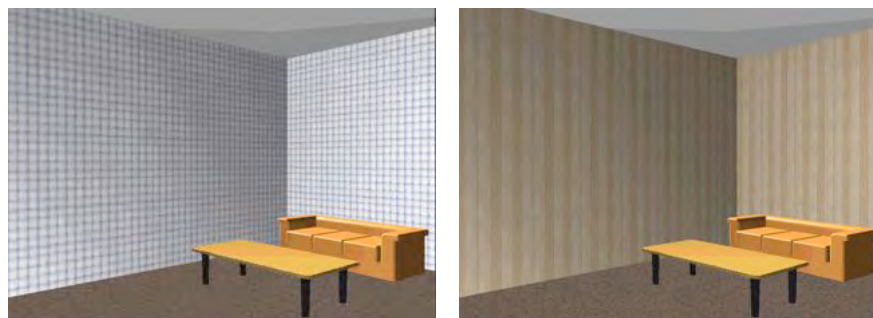Figure 5. Design suggestions for "active" room (left) and "refined" room (right)

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4. WALLPAPER TEXTURE ANALYSIS WITH 2D FFT AND RELATIONS BETWEEN KANSEI

Then we have analyzed texture of 3 samples. The samples 20,17 and 11 have almost same greyish beige color. Although they differ only on texture, their corresponding Kansei is rather different as seen in Fig.6. Sample 20 has square check and evaluated high on "adult" and "calm". 17 has smaller triangle texture, vertical stripe and is "adult", "sober" and "dark". 11 has larger triangle texture and more "heavy".
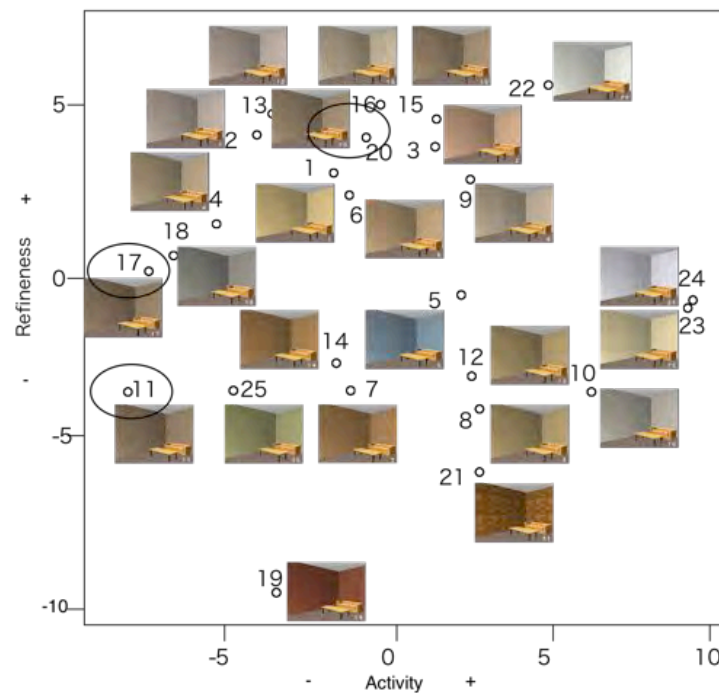

Figure 6. PC score plot of samples

We have analyzed these samples with 2D FFT. The sample picture sizes 255 x 255 pixels. 2DFFT shows horizontal frequency distribution along direction of x axis. Vertical frequency distribution was shown along direction of y axis. Oblique components are shown on orthogonal orientation. Left down corner shows the 1 cycle. FFT computation program was written in Mathematica, based on Prof. Andrew Dougherty's code [2].

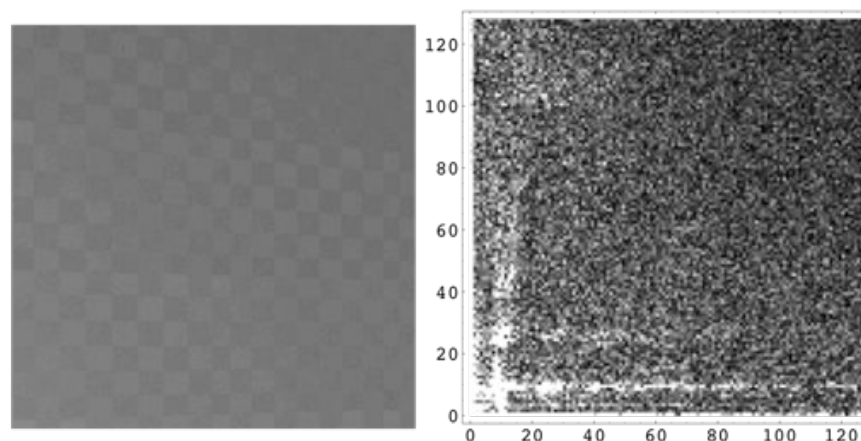Figure 7. Sample 20 (left) FFT result (right)

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On sample 20 (Fig.7), white dots are lined around 9 cycles on both horizontal (y axis) and vertical (x axis). These correspond to 255/9=28 pixel. Since size of a check of 4 blocks is near 28 pixel, the white lines show this check and its higher harmonic components.
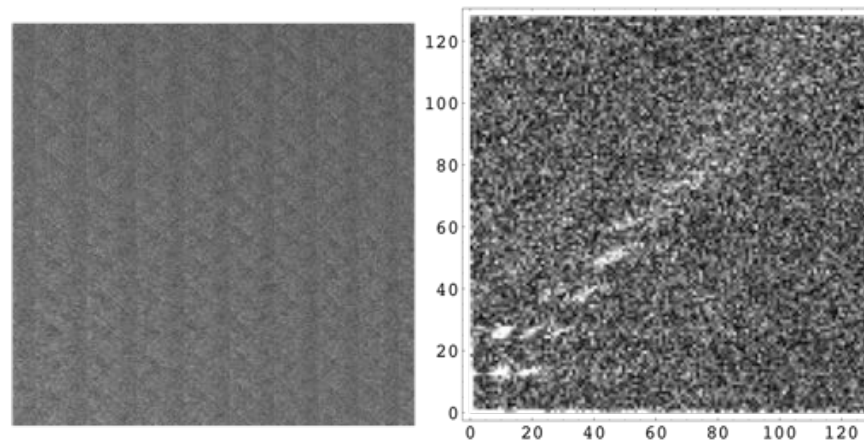

Figure 8. Sample 17 (left) FFT result (right)

In sample 17 (Fig.8), orthogonal white dots suggest the oblique components, There are peaks along 9 to 11 and 18 cycles. The former corresponds the large vertical stripe (30 pixel) and latter corresponds to the height of the triangle texture (14 pixel).
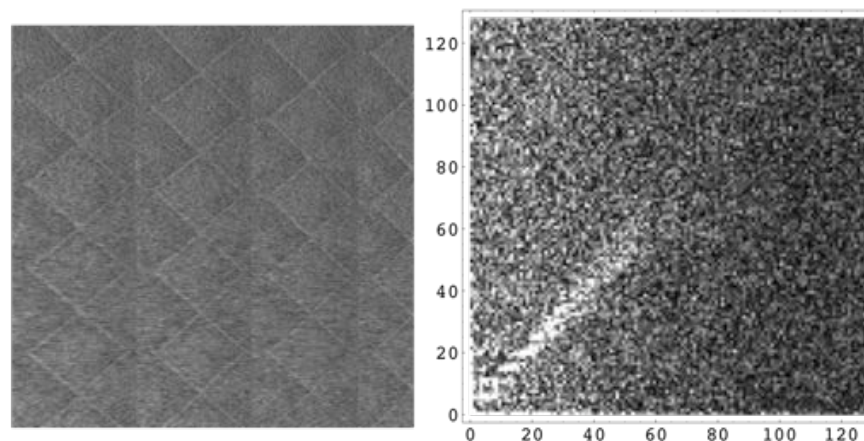

Figure 9. Sample 11 (left) FFT result (right)

In sample 11 (Fig.9), there are oblique components stronger than the sample 17, especially on lower to middle frequencies. On the x axis, there are peaks on 4 and 8 cycles. The former is large vertical stripe (70 pixel) and the latter is the height of the triangle (30 pixel). On the y axis, there is a peak around 20 cycle and is corresponds to the size of the triangle base (58 pixel).

The triangles have many frequency components than square checks. Even within the triangles, as lower frequency components increase, "activity" decreases and tends toward "heavy" Kansei.

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5. ANALYSIS OF DASHBOARD LEATHER GRAIN PATTERNS WITH 2D FFT AND RELATIONS BETWEEN KANSEI

5.1 Evaluation Experiment of Leather Grain Pattern

Twenty-four leather grain pattern samples those used in the evaluation were made on plastic film with different fabrication conditions. From 4 basic patterns, variations were made with 5 different heat pressing conditions.

Kansei evaluation was done with 20 participants. Ten participants were female and other 10 were male, all of them were students.

5.2 2D FFT analysis of Leather Grain Pattern

All leather grain patterns were taken with digital single-lens reflex camera. Same as wallpaper case, 255 x 255 gray scale data were used for analysis.
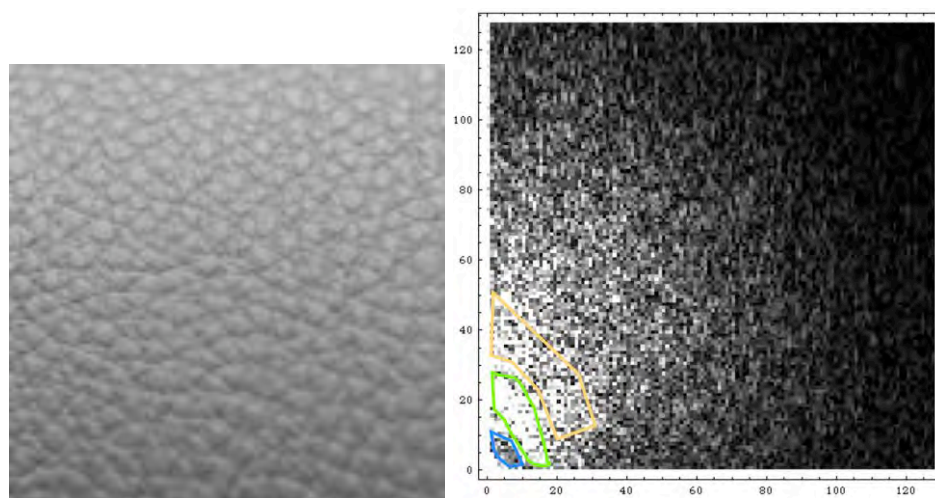

Figure 10. One of master pattern sample (left) and FFT result (right)

Figure 10 shows the one of the master pattern. The result shows the 3 different round arch areas. The 1st arch (darker area) locates the most lower frequency region in the 2D FFT spectrum, from 5 to 10 cycles of horizontal and vertical axes. This arch means lack of lower frequency. The 2nd arch (brighter area) locates the outside of the 1st arch. This arch is from 10 to 20 cycles at the horizontal axis and from 10 to 30 cycles at the vertical axis. This arch shows the dominant peak of leather grains those have round or rhombic shape. The 3rd arch which locates outside of the 2nd arch also shows the anisotropic nature of the pattern. Leather grain pattern of this sample is little longer along with the horizontal direction than vertical direction.

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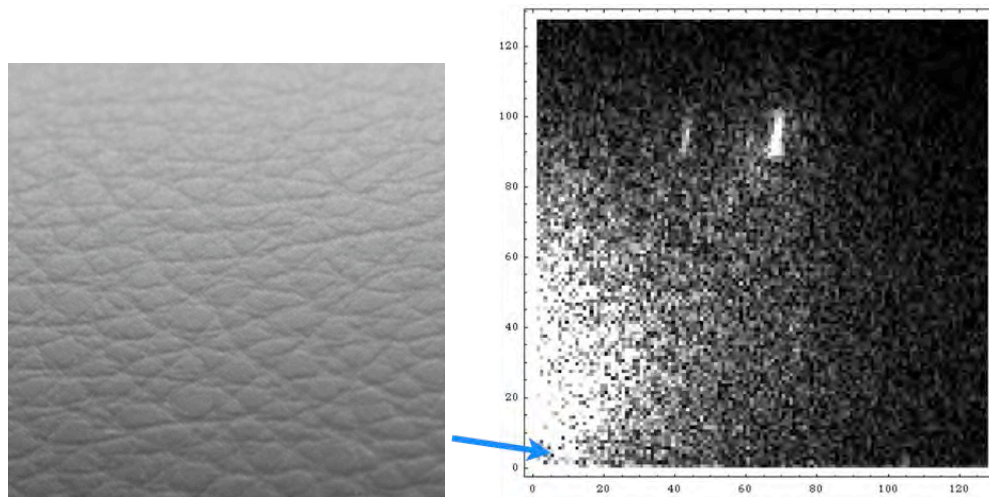Excellence; 20-22 August; 2008 in Helsingborg; Sweden

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Figure 11. Variant pattern sample (left) and FFT result (right)

Figure 11 shows the one of the variant pattern and its analyzing result. The pattern was made with more stretching than the master. 2D FFT spectrum shows lower frequency surge in lower left corner. Two isolated peaks on the upper side corresponds small granular textures caused with the stretching process.
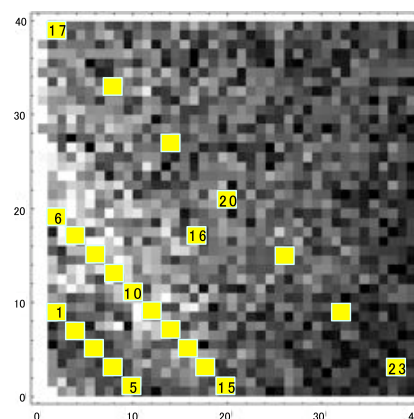
Figure 12. Re-sampling points on the 2D FFT spectrum
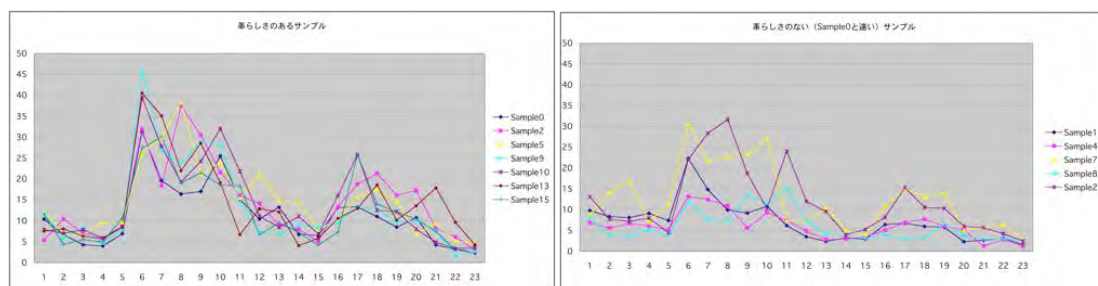
Figure 13. Power chart of re-sampled points value. Left: Highly evaluated samples of "Authentic" and "Premium", Right: Slightly evaluated samples.

We have re-sampled value from the 2D FFT spectrum for exploring the relations between Kansei evaluations. We have compared power of these re-sampled points between samples have highly evaluated on "Authentic" and "Premium" and slightly evaluated samples. The differences between two kinds of samples are apparently shown in Figure 13. Highly evaluated samples have surge on point 6 to 8 and gradually power falls. Slightly evaluated ones have not large surge and not show

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decrease along the line. Also, highly evaluated samples have a surge on point 17 and decay along the line. Slightly evaluated have not such feature.

6. CONCLUSION

In this paper, we have presented a methodology that combines the common procedures of Kansei engineering and a signal processing technique.

Common Kansei engineering procedure is useful at finding relations between salient design features and Kansei evaluation. In wallpaper case, the salient features are colors and patterns like stripes, check and unpatterned. These features are foreseen to have decisive effect on Kansei evaluation.

Pattern analytic, signal-processing methods seems excellent on detailed design effect, many of those are unforeseen. Sample 20,17 and 11 have just same color and texture only is different.

Dealing with detailed design is difficult in common KE methods. In this leather grain case, all samples have exactly same color. Incorporating all of details into design element table and solving the equations to get weights on them are almost impossible. Exploring details with signal processing methods and comparing between samples are promising way to understanding delicate design features and Kansei.

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Driving profitable growth: A study of essential management practices

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Abstract

Purpose – The purpose of this paper is to examine how different management practices drive profitable growth and business success in Danish companies.

Methodology/approach – Both qualitative and quantitative research are conducted to study the relationships between eight general mangemement practices and key performance results. A survey among large companies in Denmark and the companies' key performance results forms the empirical basis for the study. Two central key performance results are 'increase in turnover' and 'return on invested capital'. It can be argued that sustained increase in turnover and high return on invested capital at the same time indicate profitable growth and return to shareholders in the long run.

Findings – The findings provide evidence that the eight management practices are linked to key performance results. The high-performing companies differentiate significantly from the low-performing companies with regard to how well they do the management practices. All eight mangement practices are essential in producing profitable growth.

Research limitations – This study is limited to the eight identified management practices in large Danish companies.

Practical implications – This study has clear implications in terms of identifying and measuring the importance of essential management practices which influence profitable growth and thereby separating the facts from the fads.

Originality/value – The study identifies and measures eight essential management practices and links these to actual key performance results.

Key words: Profitability, Growth, Key performance results, Management practice, Denmark

Paper type: Research paper

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Introduction

Sustainable and profitable growth is central for most companies. In the 1990s the focus of international business was on growth to a large extent without even considering profitability. After 2001 and econimic doldrums the pendulum went towards earnings, primarily through streamlining and rationalization. In recent years focus has been on profitable growth through a balanced otimization of the business instead of unilateral focus on growth or streamlining. This assesment is supported by a study on market related opportunities, challenges and efforts among the 500 largest Danish companies (Jørgensen & Grønholdt, 2005; Grønholdt & Martensen, 2005). This study is conducted in 2004 by the Danish management consulting company Stig Jørgensen & Partners (www.sjp.dk) and Copenhagen Business School (www.cbs.dk). Back then 65% of the interviewed top managers stated that their primary focus was on balanced optimization of the business, only 16% stated to have a one-sided focus on rationalization/streamlining, and 19% had a unilateral focus on organic growth.

The challenge for most companies is therefore to achieve sustainable and profitable growth. New management ideas, principles and tools – some are only buzz-words - heat up and fizzle out. Which ones are critical for companies when it comes to outperforming the competitors? While academics and executives debate the mix of management tools and techniques that companies must implement to achieve high performance, there is a growing urgency to identify the common practices that separate the leaders from the laggards. The purpose of this paper is to examine how different management practices drive profitable growth and business success in Danish companies.

This research is initiated and conducted as a joint research project with Stig Jørgensen & Partners and Copenhagen Business School.

Research framework

On the basis of an extensive study of literature we have chosen to lean our analysis approach onto the Evergreen Project reported under the powerful headline: *What really works* (Joyce, Nohria and Roberson, 2003a, 2003b; Nohria, Joyce and Roberson, 2003). The purpose of the study was to find the management practices that truly can help a company to be great – to achieve evergreen business success. This five-year study involved leading academics at business school faculties of 10 universities and leading consultants in a systematic analysis of the practices that create business winners. In the study, more than 200 well-established management practices that were expected to affect business success - ranging from broad areas (e.g. strategy and innovation) to specific practices (e.g. 360-degree performance reviews and supply chain management) - were identified. The Evergreen team analyzed 160 companies over a 10 year period (from 1986 to 1996). First, it was examined how each of the more than 200 management practices were employed in each company (scored on a 5-point scale from 'poor relative to peers' to 'excellent relative to peers'). Then documents were collected and analyzed (e.g. financial statements, newspaper and magazine articles, governments filings and analysts' reports) concerning these companies in order to estimete their total return to shareholders. Taken together, these two sets of analyses give the oppourtunity of a cause-effect analysis in search of the management practices that directly correlate with superior performance.

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Joyce, Nohria and Roberson (2003a) (Nohria, Joyce and Roberson, 2003) identify eight general management practices correlating strongly with sustained business success. These essential management practices, in the authors' own words, are:

- **Strategy**: Devise and maintain a clearly stated, focused strategy
- **Execution**: Develop and maintain flawless opeational execution
- **Culture**: Develop and maintain a performance-oriented culture
- **Structure**: Build and maintain a fast, flexible, flat organization
- **Talent**: Hold on to talented employees and find more
- **Innovation**: Make industry-transforming innovations
- **Leadership**: Find leaders who are committed to the business and its people
- **Mergers and partnerships**: Seek growth through mergers and partnerships

The study find, that the first four practices are the "primary management practices" representing the fundamentals of business, and the last four are "secondary management practices". Sustained success is associated with high scores (e.g. excellence) in all four of the primary management practices and in any two of the four secondary mangement practices. From this examination emerged the 4 + 2 formula that is the heart of the publications from the Evergreen project: 4 + 2 equals business success. Joyce, Nohria and Roberson (2003a, p. 23) state that the 4 + 2 formula is a set of approaches that "tell managers precisely where to focus their efforts and where not to". The study reveals that "a company that consistently follows this formula has better than a 90% chance of sustaining superior business performance" (Nohria, Joyce and Roberson, 2003, p. 44). As a supplement to the results of their extensive study Joyce, Nohria and Roberson (2003a) have develped a list of behaviors that supports excellence in each practice, discuss examples of winning companies and losing companies, and present a set of core readings for each of the eight management practices.

In a review of the book *What Really Works* (Joyce, Nohria and Roberson, 2003) Miller writes (2004, p. 83): "It is the most comphrehensive and exiting single piece of empirical research on the subject, I have ever encountered. The authors provide compelling evidence and reasoning to support the assertion that a management's actions did indeed act as key causal factors in the corporate results eventuated…"

Research methodolgy

The Evergreen research has inspired us to study the relationships between these eight essential management practices and key performance results for Danish companies. For reasons of triangulation, both qualitative methods and quantitative methos are used for the collection of data. Initially, explorative and qualitative research is conducted in the autumn of 2006 through depth interviews with 34 top managers from the 150 largest Danish companies. The purpose is to check the face validty of the eight management practices in a Danish context, to validate the research framework, and to develop a questionnaire for the following survey. The overall conclusion is that the eight essential management practices make sense and is assested as drivers for profitable growth by large Danish companies – ofcourse with a variation in degree of importance. Most important is the classic desciplines as strategy (including strategy development and implementing), leadership and execution. Clarification on results from the qualitative research are reported and discussed by Jørgensen et. al (2007).

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A questionnaire is designed consisting of 53 survey questions capturing the eight essential management practices. The questions are based on Joyce, Nohria and Roberson's (2003a) operationalization of the eight management practices, other literature studies, practical experiences together with results from the qualitative research. The questions are formulated as statements to which the respondent was asked to evaluate: "how well do the following statements fit your company for the past five years?" on a 7-point scale (from 'not at all' to 'extremely well').

With regard to investigating what really drives return on invested capital and increase in turnover, a survey was conducted during January 2007. The data included 190 interviews with top managers from top 1000 companies in Denmark, and the respondents expressed their perception of the extent to which the eight management practices has been deployed in their company.

The answers were linked to the companies' key performance results in the years 2001-2005 based on data from financial statements. We use the companies' actual performance results and the annual average over the five-year period. The sample was reduced to a total of 144 companies, as financial data were incomplete or not available from 46 companies.

Two central key performance results are 'increase in turnover' and 'return on invested capital (ROIC)'. It can be argued that sustained increase in turnover and high return on invested capital at the same time indicate profitable growth and return to shareholders in the long run. Figure 1 presents a map combining these two key performance results. We have chosen to measure a company's performance results in relation to the business median, so in fact we distinquish between the top 50% and the bottom 50%. Within an industry, each company may be placed in one of four cells in such a map, and the four cells can be interpreted in useful ways giving the platform to characterize four different types of companies with various strategic challenges.

Figure 1. Caracterizing high-performing and low-performing companies

The upper-right cell contains high-performing companies that are among the 50% best of their industry when it comes both to increase in turnover and return on invested capital.

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On the other hand, the lower-left cell consists of low-performing companies, characterized by being among the 50% worst in the industry when it comes to both performance results. Those companies face challenges in both increase in turnover and return on invested capital compared to the other companies in the industry.

Companies in the lower-right cell only face challenges within return on invested capital while companies in the upper-left cell face the challenge to create increase in turnover.

The distribution of the 144 sampled companies is as follows: 48 high-performers, 47 low-performers, 23 in the lower-right cell, and 26 in the upper-left cell.

Findings and discussion

Data analyses have been carried out to assess the included management practises and their relationship to financial performance. One analysis approach is to compare high-performming companies' and low-performing companies' scores on the eight management practices. Table 1 shows both high-performers' and low-performers' answers to selected survey questions reflecting areas of the eight management practices.

All differences between high-performers and low-performers are significant (tested by a two-group z test for equality of proportions; all p's < 0.1) and this comparison clearly confirms that the high-performers differentiate significantly from the low-perfomers with regard to how well they work at their management practices. The five greatest differences between high-performers and low-performers are obtained on these survey questions:

- Our company is very capable of doing business regardless of the market conditions (strategy); difference 30%-point, relative difference 107%.
- The corporate culture inspires everyone to do their best (culture); difference 29%-point, relative difference 81%.
- We have a very well established set of company values (culture); difference 27%-point, relative difference 71%.
- Our corporate culture contributes to attracting, keeping, and developing new talents (talent); difference 25%-point, relative difference 109%.
- Top management pay is directly dependent on the economic performance of the company (leadership); difference 25%-point, relative difference 76%.

Two relative differences are extremely great, indicating that the high-performing companies are twice as good as the low-performing companies to

- have capability of doing business regardless of the market conditions (strategy)
- attracting, keeping, and developing new talents (talent)

Table 1. High-performers' and low-performers' scores on selected survey questions

"How well do the following statements fit your company for the past five years?" is evaluated on a	High-	Low-	Dif-	

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7-point scale (from 'not at all' to 'extremely well'). The table shows the percentage answering 'very well' or 'extremely well'	performers	performers	ference	z value
Strategy				
There is a strong relation between our vision, mission, and the corporate strategy	71	51	20	1.97 **
We are focused on long term strategies rather than short term solutions	63	45	18	1.74 **
We monitor and adjust the corporate strategy continuously	65	51	14	1.33 *
The strategy implementation process is deeply rooted across functional borders of the organization	31	17	14	1.63 *
Our company is very capable of doing business regardless of the market conditions	58	28	30	3.01 ***
Execution				
We deliver products/services that consistently meet the customers demand	69	53	16	1.56 *
Culture				
The corporate culture inspires everyone to do their best	65	36	29	2.79 ***
We have a strong customer oriented corporate culture	58	45	13	1.33 *
We have a result oriented corporate culture	69	47	22	2.17 **
We have a very well established set of company values	65	38	27	2.57 ***
When errors and mistakes are made we use it for learning and improvement purposes	48	34	14	1.38 *
Structure				
We are organized according to the most important value creating processes for the customers	36	21	15	1.60 *
We are organized according to main customer segments	58	38	20	1.95 **
The organization ensures the necessary resources	46	32	14	1.39 *
Talent				
Our corporate culture contributes to attracting, keeping, and developing new talents	48	23	25	2.49 ***
We have training and educational programmes for employees at all organizational levels	29	13	16	1.96 **
Leadership				
Top management gives room for self management	71	54	17	1.65 **
Top management pay is directly dependent on the economic performance of the company	58	33	25	2.44 **
Innovation				
Our innovation process is very consumer driven	38	20	18	1.93 **
We have an established and formalized innovation process, which is cross functional	21	7	14	2.03 **
The gap between planned and realized innovations have diminished	21	11	10	1.35 *
Mergers and partnerships				
We continuously evaluate the opportunities for entering new strategic partnerships	48	33	15	1.52 *

* Significant at 10% level, one-tailed ($p < 0.1$)
** Significant at 5% level, one-tailed ($p < 0.05$)
*** Significant at 1% level, one-tailed ($p < 0.01$)

An indication of the importance of the eight management practices is obtained by studying the average differences between the survey question answers within each management practice. When doing this the biggest average differences between high-performers and low-performers are gained for strategy, culture, leadership, and talent with average differences 19-

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21, e.g. somewhat similar. These management practices discriminate mostly between high-performers and low-performers. So it is the classic areas, which separate the biggest Danish companies in creating profitable growth.

Conclusions

Findings and contribution to the field

The study quantifies and measures eight management practices and links these to actual key performance results. The eight management practices make good sense to Danish top managers. We analyze the relationships between the eight management practices and financial results, and in this way the data presented in the paper provide evidence that the eight management practices are linked to key performance results. The findings reveal that high-performing companies - compared to low-performing companies - work better on all eight management practices, and that all eight mangement practices are essential in producing profitable growth. Successful companies ought to master the management practices.

Limitations and suggestions for further research

This study is limited to the eight identified management practices. It is posssible that an alternative structure of management practices – or other management practices – may provide even more powerful conclusions. In here lies a suggestion for further research.

The study is conducted among large Danish companies. However, we believe that many of the findings are transferable to other companies which could be interesting to examine more closely.

In this study actual key performance results collected from the companies' financial statements over a five-year period has been used. These key numbers may of course be influenced by strategic and financial considerations, acquisitions, mergers, etc., and therefore results from financial statements may not be accurate for all companies with regard to our objective. This involves the key numbers of company specific and industry specific conditions as well. Therefore it can be valuable to take a closer look into measuring business success and profitable growth. This could be a relevant direction for further research.

After a further research into these areas it may be possible to carry through a model-based analysis to document even stronger connections and new relationships between management practices and profitable growth. This will also have even stronger managerial implications.

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A systematic approach to achieve
operational excellence in hotel services

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Abstract

Originality/value: The value of this paper is related to the transfer of industrial methods to the service sector. Moreover not only the single methods are transferred but they are also integrated into a global systemic approach to operational excellence in services. This has been deployed in two phases: a "hard" phase to support the design of the service and the construction of tangible and intangible elements of the service, and a "soft" phase to support the management, maintenance and improvement of the service delivery. All this has been applied to the hotel service sector where the interaction between tangible and intangible elements of the service are particularly evident. Only few works in literature have tried to transfer industrial methods for operational excellence to services. But the major originality of this work lies in the proposal of a systemic approach to operational excellence, that integrates several methods in a unique framework.

Purpose: The purpose of the framework here proposed is to introduce an industrial culture within the service organizations. Concepts such as employees empowerment, ownership, continuous improvement, together with the systematic implementation of quantitative methods builds the organizational basis for achieving operational excellence in services, reducing costs and increasing service quality.

Methodology/approach: The framework here proposed uses and integrates several methodologies. Quality Function Deployment is largely used in order to support the "hard" phase of the framework. Kano's model of customer requirements has been integrated in the Quality Function Deployment structure by means of an original method developed by the authors, introducing a so-called Non-Quality Priority Number (similar to the FMEA's Risk Priority Number) that in combination with a so-called Quality Priority Number drives the decisions for improvement towards operational excellence. Moreover the "soft" phase of the framework introduces methods such as Failure Mode and Effect Analysis and Total Productive Maintenance in order to improve the service organization's operational competence and culture, increasing at the same time the sense of ownership and the commitment for improvement of front line workers.

Findings: Through this paper it has been shown that industrial methods for operational excellence can be adapted and transferred to the service sector with a potential for significant improvements in

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particular for those services with a high degree of tangible factors. Allowing in this way to achieve outstanding results also without significant investments.

Keywords: Quality Function Deployment, Total Productive Maintenance, FMEA, service operational excellence, commitment and empowerment, operational culture for excellence.

Paper type: Research Paper.

Introduction

According to a recent study (PKF-HR consulting, 2006) from 2001 to 2005 hotel maintenance expenses grew 18.3 percent, almost 33 percent more than the pace of growth for all other hotel operating costs during the same period. This is the consequence of the increased importance of focusing on maintenance for improving customer satisfaction. Guest satisfaction is indeed impacted by the first impression people experience when they enter their guestroom. Immediately, their eyes are drawn to the condition of the furniture, fixtures, and furnishings that are most evident. On the other hand it is also a consequence of low attention from hotel managers on hotel maintenance expenditures no matter they are becoming one of most relevant costs of operation. To implement cost control in the maintenance department is becoming more and more relevant. Balancing operational improvements and cost control in the maintenance department is one of today's struggles for management.

Customer satisfaction vs. need to decrease cost

Many managers are looking for the optimal trade-off between cost control and operational improvements, but maybe the real problem is not about the tradeoff, but about the ability to obtain the first promoting the second. What is needed to achieve this?

The authors believe that there is the need for a systematic approach which enables to implement a continuous improvement culture, service excellence and customer orientation, in one word the implementation of an industrial culture of operational excellence.

There is the need for the ability to see a hotel as a single system, for developing policy, strategies and service itself, and structuring all its processes efficiently and effectively through its operations.

There is the need for a systemic approach for operational excellence, that means to develop a culture and tools which enable to achieve at the same time customer satisfaction and operational efficiency.

The purpose

The purpose of this paper is to structure a systematic approach for the service sector, especially for hotel services sector, in order to enable to achieve operational excellence.

A systematic approach based on two key pillars:

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- An industrial culture of operational excellence, which focuses on business processes and on their optimization
- A framework, set up by operative tools used to support the industrial culture.

To pursue the purpose, the authors have borrowed some tools, as QFD, FMEA, TPM from the industrial sector so that they form a single framework which can help to create and to strengthen industrial culture of operational excellence in service sector. In fact there are many similarities between today's service sector and the industrial context under which these tools were first developed, such as increased operative and overhead costs, greater customer expectations, increased workers' competence. In the industrial context QFD, FMEA, TPM guaranteed dramatic improvements, visibly transforming the workplace and raising the level of knowledge and skill in production and maintenance workers. The authors believe that analogous goals can be pursued in the service sector, and this is the reason why the authors have chosen these tools to develop the systematic approach.

Every change needs methods and a vision: TPM, FMEA and QDF linked together in a framework are the method, the industrial culture of operational excellence is the vision.

The hotel sector is an ideal case study for applying conveniently adapted industrial tools, because its service are, for their nature, combinations of tangible and intangible elements, being its tangible elements an integral and fundamental part of hotel service itself. The tangible elements indeed have a great impact on a good service delivery and so they have to be taken under control, in the same way they had been in industrial sector as productive factor or as a product element.

A brief of state of art: QFD, FMEA, TPM

In literature QFD, FMEA, TPM are principally set in the industrial sector, in which they were born. Nevertheless recently there have been various application of these tools in service sector too (Mazur 2003, Dudam Pess 2003) even thought there are still few application in hotel services (application of QFD methods in Ritz- Carlton and Marriott hotel for better understanding crucial customer-supplier relationships, Kirk, Galanty,2004).

QFD, TPM and FMEA are all tools that have been fully analyzed in all their aspects, but normally authors analyze them individually. Indeed there are only few applications which link together two out of three of this tools, QFD and TPM (Pramod et al., 2006; Pramod et al. 2006), or QFD and FMEA (Ginn et al., 1998), but without significant applications in the service sector. But, most importantly, there is a lack of applications linking together all three tools, TPM, FMEA and QFD, building a one all-embracing tool, which faces under different points of view all aspects that impact on customer, from service/product definition and delivery, to the organization supporting the service.

The authors want to link together the three tools QFD, FMEA and TPM, developing a framework that will be the operative tool of the systematic approach for a change in the service sector way of thinking.

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The "hard" phase and the "soft" phase

The authors have developed the framework part of the systemic approach in two phases for supporting hotel organizations in their life cycle:

- A "hard" phase, in which there are the structural changes and in which there are bigger investments,
- A "soft" phase, in which the goal is to maintain and improve what has been implemented in hard phase.

The hard phase can involve all the hotel or only a part of it and can be implemented during a reorganization, a restructuring or the planning/design of a new structure.

The hard phase is set up by the definition of 3 Building Blocks (BBs), that are matrixes borrowed from QFD tool.

The soft phase uses the first phase's BBs, which are simplified after management choices, for implementing FMEA and TPM tools to pursue organizational continuous improvement.

The soft phase, is normally subsequent at hard phase, but it could be put in practice as a stand alone.

The systematic approach's hard phase

The hard phase is composed by 3 BBs (figure 1) , matrixes which come from QFD's House of Quality (HoQ) (Hauser and Clausing, 1988), defined by Akao (Akao, 1990) "as a method for developing and design quality aimed at satisfying the customer and than translating the customer's demand into design targets and major quality assurance point to be used through the production stage". Matrixes in the BBs, as HoQs, correlate "what" with "how" through a weight. Relationship values are defined differently in each BB because they depend on the BBs' focus.
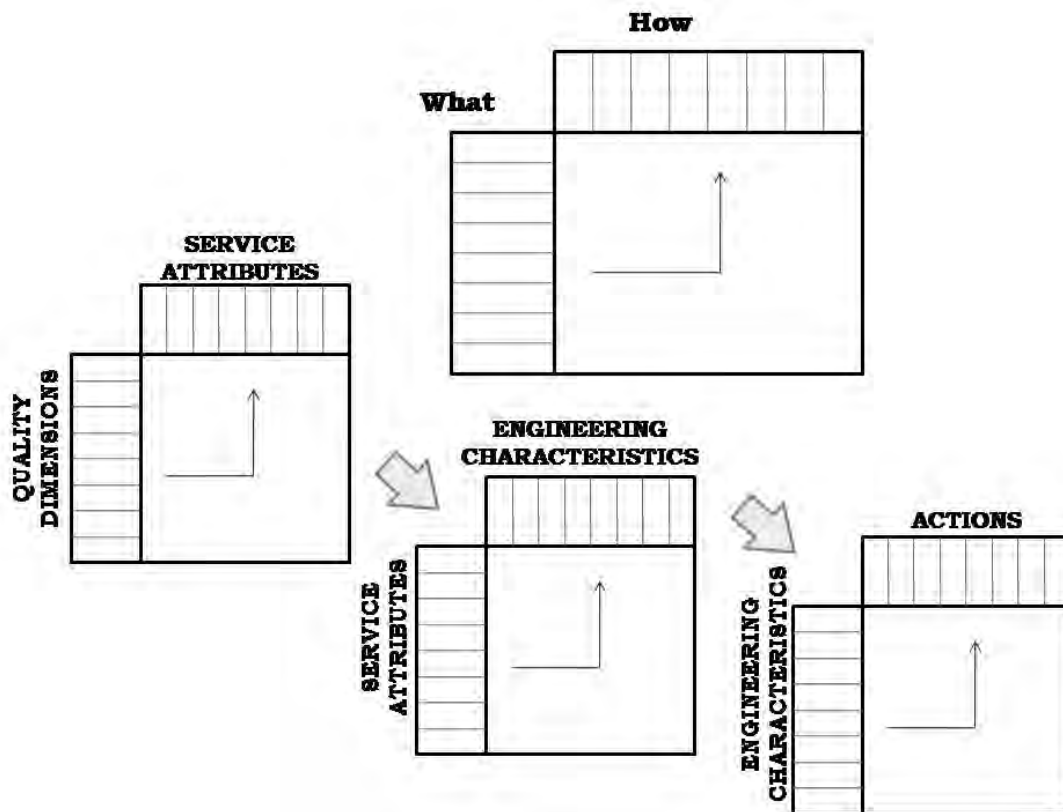
Figure 1. The three Building Blocks of the hard phase.

The first BB starts from analyzing what customers expect from a good hotel service to be satisfied. It has as "WHAT" the customer's *quality dimensions,* in which a service could be decomposed, that can be grouped together in five key dimensions defined by SERVQUAL methodology (Zeithaml et al., 1990), i.e. reliability, assurance, tangibles, empathy, and responsiveness, and as "HOW" the *service attributes*, the requirements explicitly asked for, or implicitly attended by customers (i.e. a silent room, a fast room-service, etc.).

The primary purpose of this first BB is to relate service attributes with overall customer satisfaction. In fact a customer reaches overall satisfaction when all the quality dimensions are fulfilled by the satisfaction of the service attributes. Each *quality dimension* has a weight α_i, which represents the impact of the dimension on the overall customer satisfaction. Each *service attribute* can represent an implicit or an explicit requirement, with different impact on the customers' satisfaction.

The logic which enables to consider the different impact of service attributes and that classifies requirements on this bases is Kano model's logic. Kano model (Kano, 1984) shows the variation of customer satisfaction at various degrees of customer perception for the different typologies of requirements (implicit, explicit, exciting experiences).

Let us first examine the lower semi-plane of Kano's model (figure 2), therefore differentiating service attributes on the basis of how they affect dissatisfaction, giving a priority to actions on attributes and on characteristics that set them. In order to integrate Kano's logic within the first BB, the authors have defined two parameters: Us and P.

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Us represents, varying between 0 and 5, the severity of a possible dissatisfaction caused by the lack of perception of a requirement, while P, varying in this case between -5 and 0, represents degree of lack of perception of a requirement by customers.
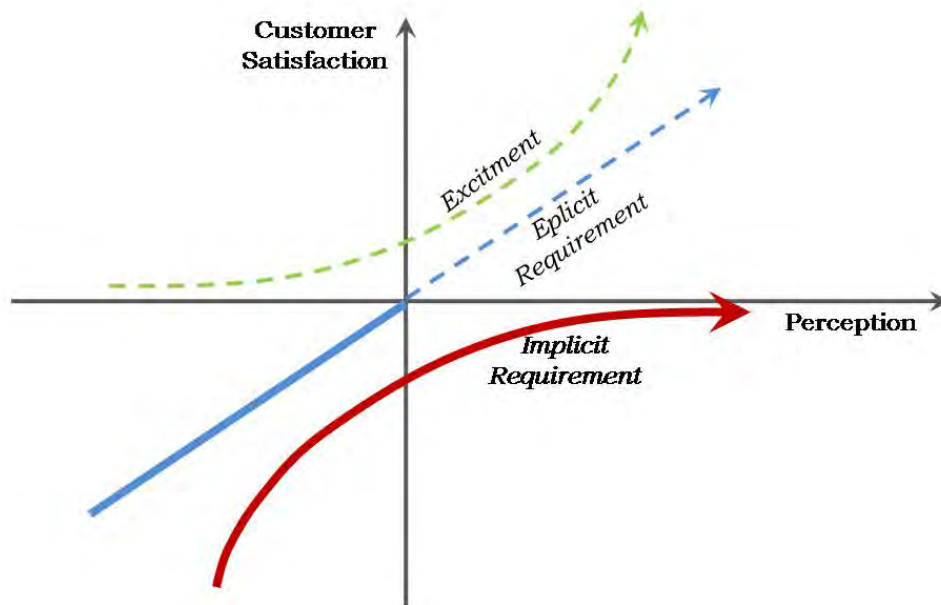
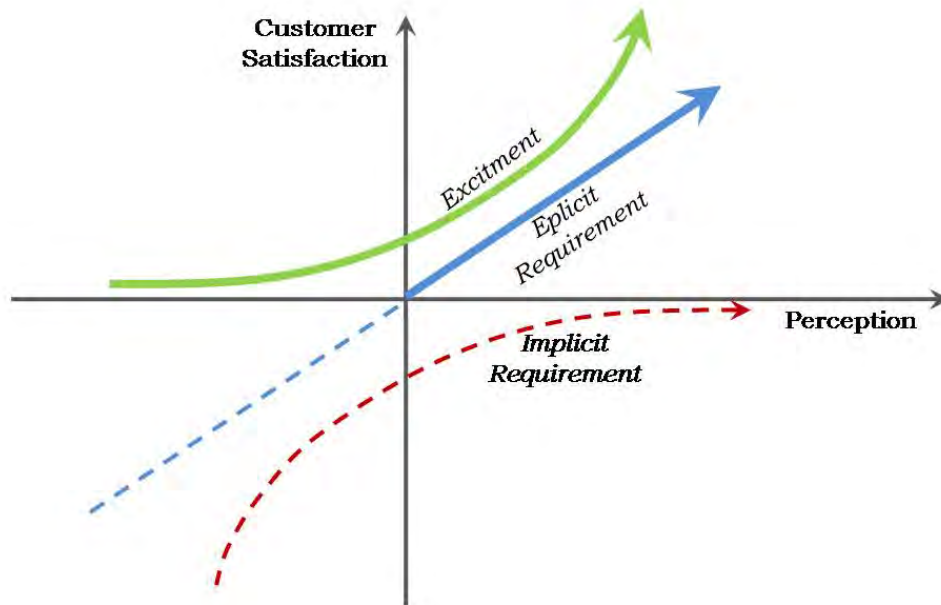**Figure 2. The lower semi-plane of Kano model.**

By means of the composition of Us and P it is possible to differentiate between implicit and explicit requirements. In fact implicit requirements generate high levels of dissatisfaction as perception decreases, therefore will have a very high value of Us (5), that once combined with a very negative perception (-5) will generate very high dissatisfaction (-25). On the other hand if an implicit requirement (even a critical one, i.e. with a very high Us) is balanced by a good perception (P=0) there is no or little impact on satisfaction. Explicit requirements, that usually a linear relationship between perception and satisfaction, will have low-average values of Us (1-3) that combined even with very low levels of perception (-5) will generate average levels of dissatisfaction.

In this way each pair of values (Us, P) represent a point on Kano's customer satisfaction curves on the negative satisfaction semi-plane.

In a similar way it is possible to identify the points belonging to the upper area in Kano's model, the satisfaction semi-plane (figure 3), representing explicit and exciting requirements. The equivalent of the Us parameter is now called S, varying between 0 and 5, representing how much satisfaction the perception of a requirement can generate in a customer. The P perception parameter in this case varies between 0 and 5.

Consequently the combination of S and P can generate very high levels of satisfaction, when the requirement is extremely sensible (high level of S) and it is highly perceived (high level of P), or

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average levels of satisfaction, for explicit requirements with average-high perception or exciting experiences with low perception. In this way the upper semi-plane of Kano's model has been represented.

Figure 3. The upper semi-plane of Kano model.

All values of P, Us and S are given to each service attribute j (Us_j; S_j; P_j) in the first BB (figure 4) and are independent from quality dimensions on which service attributes have impact. The combination of the satisfaction of all service attributes covering by means of α_i the i quality dimensions generates customer's overall satisfaction.

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Figure 4. The first Building Block of the hard phase.

The second BB (figure 5) has as "WHAT" *service attributes*, and as "HOW" *engineering characteristics*, i.e. the structural and organizational elements that impact on service attributes (e.g. the hotel wall's thickness, that impacts on the "silent room" service attribute, or the number of room service attendants that impact on the "fast room service" service attribute).

For each engineering characteristic *k*, the authors have defined other two parameters: O_k and I_{jk}.

O_k represents the occurrence of a service characteristic, i.e. the frequency with which it happens (e.g. how many walls are thick, how often do we have many room service attendants); I_{jk} shows the impact of an engineering characteristic on a service attribute (e.g. how much does a think wall impact on the room's silentness, how much does the number of room service attendants impact on room service speed).

Whilst O_k can vary from 0 (almost no occurrence) to 5 (high occurrence), I_{jk} can be positive varying from 0 to 5, or negative, varying from -5 to 0, depending on positive or negative impact the characteristic *k* might have on a service attribute *j*.

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Figure 5. The second Building Block of the hard phase.

In the lower part of the second BB the cost for each characteristic is identified, in order to be able to perform a complete cost-benefits analysis.

Through the analysis and decomposition made in second BB it is possible to achieve a complete vision on each single characteristic's incidence on customer satisfaction, in order to give a priority to characteristics according to this.

In fact, the authors have defined two indicators, NQPN (Non Quality Priority Number) and QPN (Quality Priority Number) for each characteristic. NQPN considers all attributes on which a characteristic impacts, that have Us_j different from zero, (and so S_j will be zero), and so it considers the dissatisfaction from a lack in some implicit or explicit requirement, while QPN considers all attributes which have S_j different from zero (and so Us_j will be zero), that represent the satisfaction from explicit requirements and exciting experiences.

NQPN is the product of Us_j; P_j, O_k, I_{kj} and it represents how much the absence of a characteristic can generate customer dissatisfaction through its contribution on service attributes. It can be calculated by:

$$NQPN_k = O_k \times \sum_j I_{kj} \times Us_j \times P_j$$

QPN represents how much the presence of a characteristic can increase customer satisfaction through its contribution on service attribute, and can be calculated by:

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$$QPN_k = Q_k \times \sum_j I_{kj} \times S_j \times P_j$$

Each characteristics k can have both a NQPN value and a QPN value, since that characteristic could influence both negatively and positively different requirements.

NQPN and QPN help giving a priority to characteristics compared to satisfaction or dissatisfaction level. In fact characteristics with high NQPN will have highest priority being those that generate most dissatisfaction. A correct strategy would be to choose a characteristics mix that minimizes large negative NQPN values without decreasing QPN values, and increase QPN values without decreasing NQPN values.

The last BB (figure 6) has as "WHAT" *engineering characteristics* and as "HOW" *actions* that could be realized by an organization to implement a specific characteristic.

Authors divide actions in three categories:

1. Organizational actions, i.e. actions that modify organizational aspects
2. Maintenance actions, i.e. actions that the hotel structure but only in a light way
3. Structural actions, i.e. actions that imply deep interventions on the structure.

Each characteristics can be realized through one or more actions also of different typologies. This possibility is shown by a "x" in meeting point between rows (engineering characteristics) and columns (actions).

Figure 6. The third Building Block of the hard phase.

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The choice of which action to implement for realizing a characteristic depends on which life-cycle phase a hotel is in (figure 7), if in a reorganization phase**,** a restructuring phase, or a planning/design phase of a new structure.

In fact if a hotel is in reorganization phase it can implement only organizational actions, if it is in restructuring phase both organizational and maintenance actions, whilst if a hotel is in planning/design/renovation phase it can implement all three action typologies.
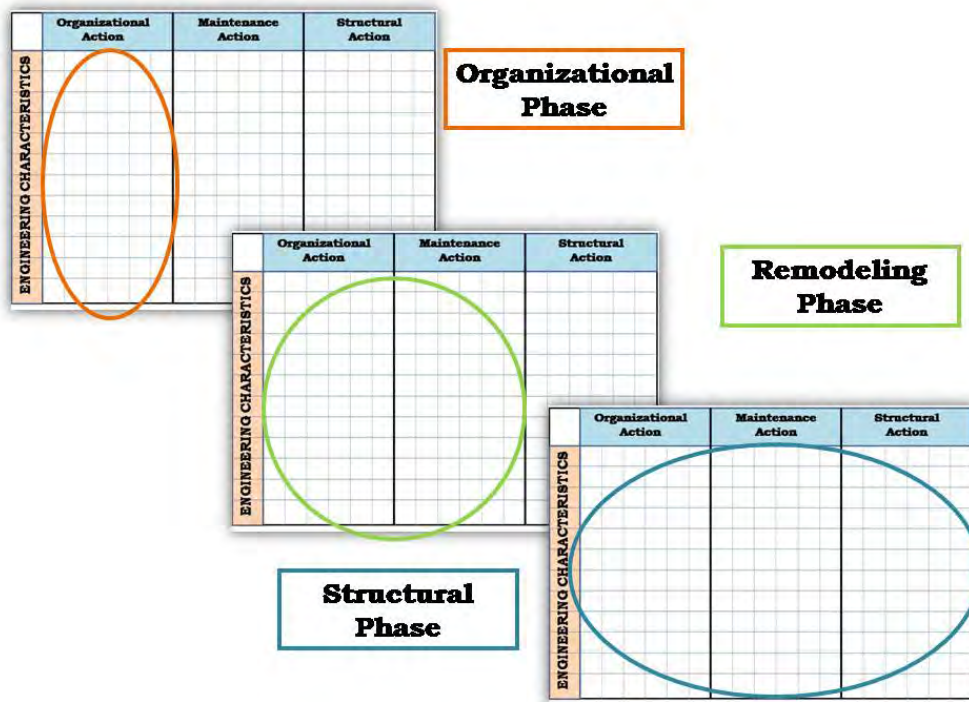

Figure 6. The choice of actions in the third Building Block.

Renovation, maintenance or reorganization?

Once an organization has developed all BBs levels, it has a complete vision of its processes, elements and characteristics, of how they impact on customer satisfaction and of the costs that each phase could imply. With all these elements an organization can perform a cost-benefits analysis and choose which kind of changes to implement.

The choice between different phases, and therefore the choice between elements, characteristics and actions to focus on, depends on the life cycle phase in which organization is, on its needs and on its budget.

Each choice changes the BBs: some elements disappear and others change their status. Each choice, indeed, changes a hotel, more o less profoundly, it generates new priorities and is the starting point for new maintaining and improving phase, the soft phase described below.

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Some consideration on the hard phase

Until now we have seen hard phase, and we have seen its big impact on hotel structure and on its organization, much more an organizational/structural impact than a cultural impact, which requires economic investment and organizational commitment.

Indeed the hard phase has a big "magnitude" but in a short time (especially compared with the soft phase). The hard phase could involve many employees but more commonly only a part of them, or even only the top management.

Top management is involved in the hard phase, analyzing the hard phase BBs and making decisions using industrial tools and way of thinking. This phase requires a cultural change towards an industrial culture, but mainly only at a management level. And this is an important starting point for an organization's cultural change.

During the soft phase this cultural change is spread to all the rest of the organization. Soft phase will instill industrial culture throughout all the organization.

The systemic approach's soft phase

The systematic approach's soft phase starts from the top management's choices made in the hard phase BBs.

The purpose of the soft phase is to preserve and continually improve all elements, both new ones put in practice from the hard phase, and already existing ones.

The approach the authors are suggesting pursue this purpose through the implementation of industrial operative tools (such as FMEA and a TPM) and through the diffusion and strengthening of industrial culture of operational excellence within the service organization.

In this phase all changes are more gradual and continuous than in the hard phase, but they have a deeper impact because they touch every employee in his/her behavior, their daily work, and their approach to their job on the long term.

It is also possible to realize the soft phase without implementing the hard one. In this case, however, a service organization would have to implement industrial tools and develop an industrial culture among employees without being sure of a strong industrial culture in the top management, with the risk of probably less results and less benefits. In this case BBs elements will derive from an analysis on the service, processes and hotel characteristics that already exist.

The BBs, indeed, are core elements on which the soft phase will base the implementation of the industrial tools of FMEA and of TPM, which help to maintain and to realize continuous improvement of hotel service and of all its parts as well as to introduce and develop an operational excellence culture in all employees. They also give a guideline to top management, and to all employees consequently, on what to focus their resources and their attention on.

BBs, deriving from the hard phase and the top management's choices, produce a list of engineering characteristics which have an impact on customer satisfaction and on the service attributes. Passing from the hard phase to the soft phase, a hotel organization needs to add a further BB, which has as

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"WHAT" the engineering characteristics already implemented in the hotel, and as "HOW" the part characteristics that compose them. In this way it is possible to have a complete vision on all single part implemented. On these "parts elements" the authors have put in practice FMEA and of TPM tools. Let's start with FMEA tool.

FMEA tool pays attention on single elements, on their failure mode and relative causes, on identifying them in advance, in order to train employees to prevent their occurrence and to face them when they happen, as well as to make action for improvement.

FMEA tool asks to identify for every part characteristics its relative potential failure mode and for each failure mode 3 elements:

- Severity (S), the seriousness of the effects of the failure; the severity rating applies only to the effect
- Occurrence (O), the frequency of the failure - that is, how often the failure can be expected to take place.
- Detection (D), the ability to identify the failure before it reaches the end user/customer.

Every element, S, O, D, is given a value from 1 to 5, based on part characteristics analysis and on historical data.

Multiplying severity, occurrence and detection ratings we obtain the Risk Priority Number, ($RPN = S \times O \times D$), a measurement of the relative risk, used to prioritize actions and resources.

RPN enables to define a part characteristics ranking, based on their relative risk, which could be used by top management to optimize employees' efforts on part characteristics which have an impact, even if indirectly, on customer satisfaction.

Two additional considerations about RPN.

1. When one of the three elements, S, O, D, is zero, and so it is not possible to identify part characteristics failure, or failure doesn't happen or it is impossible to find it or it hasn't any serious effect, RPN is zero, and so the importance to focus on that part characteristics disappears.
2. RPN value changes over time, as a result of corrective and preventive actions made on the element, so it needs a dynamical/continuous analysis.

It is quite evident that the FMEA concept has been the basic concept on which the QPN and NQPN have been developed. However FMEA tool used in the soft phase and in the hard phase are quite different, since in the first case the authors adapted this tool to work on a special "failure", that is the incapacity to understand customer expectations and their importance, in order to understand the relative importance of engineering characteristics which have a direct impact on customer satisfaction. Instead in the soft phase FMEA is used to understand the actual failure mode of part characteristics. But combining the two uses, RPN gives additional information to the users than in ordinary FMEA applications. Not only how much it is important to pay attention to a characteristic part for its failure mode consequences, but also how much a potential part characteristics' failure mode impacts on customer satisfaction. This since all part characteristics are related to engineering

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characteristics (through the additional BB) which are related to customer satisfaction through their QPN and NQPN.

Another industrial tool used by the authors in the soft phase for building a systematic approach for operational excellence is TPM. Total Productive Maintenance (TPM), is a tool mainly focused on operations, production processes and maintenance, but also on some cultural and structural aspects as empowerment, commitment and training. These elements enable all employees to develop their full potential. TPM consequently helps to build the cultural aspects and the methodological aspects of the systemic approach.

The authors have focused their attention on TPM's aspects related to efficiency increase of the hotel facility ("plant") through autonomous and preventive maintenance, rather than on other TPM aspects, such as TPM for office that distracts the attention from operation in favor of services that support operation.

As said before, hotel services rely on tangible elements just as on intangible elements, and for this reason TPM fits very well. The tangible elements of a hotel, on which TPM can be applied, are its facilities, therefore both the location in which services are performed (bedroom, bathroom, restaurant, etc.), and the equipment used by employees (for example cleaning trolley). The authors have adapted the "5S" (Seiri- Sort, Seiton- Systematize; Seiso- Sweep; Seiketsu- Standardize; Shitsuke- Self Discipline) and seven out of eight TPM pillars (with the exception "office TPM") to both of these elements.

But what does implementing TPM in hotel services really mean?

It means to analyze each part of the service activities and their respective tangible elements to find which of these activities and elements create value and which could be eliminated; it means to preserve neat and clean the "plant" (the location in which services are performed, but also the employees support equipment) to reduce the time for maintenance or improvement interventions, for finding any lack or mistake; it means to describe activities, operational standards, procedures, as well as to define check lists to increase activities speed and reliability; it means to standardize elements, activities, support equipment to reduce supply level and replacement variability. It means for every employee to own a part of the facility and to take care of it, repairing failures and improving its performances autonomously, being accountable and proud for its own job and for its results.

Autonomous and preventive maintenance, the 5S, training, are all TPM elements, here briefly described, which can help a reader to have an idea on what TPM in hotel services might mean.

Autonomous, preventive and quality maintenance, become more and more sustainable and profitable as the level of experience and competence of the employees increases. Training courses are made to increase employees' competences to achieve their full potential. 5S help to achieve gradually and systematically a better workplace in which eventually problems are visible and in which it is easier to work well and to implement other the TPM pillars.

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In this way each employee not only is able to preserve the "status quo" but also to continually improve and make part of the facility he/she "owns" more and more effective.

Finally a well organized workplace motivates people, improves safety, work efficiency, productivity and encourages ownership.

A practical example of TPM in this approach?

One can start for example from making each hotel cleanser accountable for a fixed range of rooms (that will become his/her rooms) providing him/her with the priority list resulting from FMEA failure mode analysis on the elements of those rooms and their relative consequences and customer's visibility (RPN, QPN, NQPN). The cleanser is free to make a decision on those elements, which can be improved or modified to optimize them and their spare parts, as far as there is an evident return from this (for example, he can change all light bulbs in all the rooms he is accountable for, in order to standardize them, minimizing spare parts, and possibly do this in agreement with the other room owners in order to achieve scale economy). The cleanser can define a check list which can help him/her to remember and to find solutions to improve his/her activity. And finally he/she will be measured on the overall performances of his/her rooms.

Which results can be achieved with TPM in hotel services?

Lower cost for ordinary maintenance, because some of it is performed by internal employees, reducing external maintenance costs; lower extraordinary maintenance and so not only lower cost but also lower customer dissatisfaction and element unavailability.

Wider employee satisfaction for a wider employee commitment and empowerment, caused by wider operative discretionary and training.

Continuous improvement in all aspects in which employees are committed, and so continuous improvement in all hotel service.

Operational culture becoming in this way effective throughout all the organization and in all its employees, because each of these really know, at different levels, hotel operative processes and their relative elements, as well as they have visibility on how their work contributes to the hotel overall success and are rewarded for this.

Possible benefits

Why should a hotel service organization use this approach? Why should industrial tools and methods be used in the service sector, and especially in the hotel sector?

Because the approach that the authors propose is a systematic approach which analyzes the organization in its deepest aspects and which enables that organization to raise a question to itself about the services it develops or that will develop, building them on customer expectation.

Because the systematic approach is a tool that helps to analyze a problem and its relative cause, breaking it in sub-problems, finding variables that have an impact on the problem and on which it is possible to act.

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Because it is a tool that helps an organization, from the management to the operative workers, to know profoundly its processes and their relative component parts, with their failure mode and effects, having as results better control on variables that have an impact on customer satisfaction.

More foreseeable and controllable processes mean more robust processes (a robust process is a process that can reasonably expected to produce consistent results with very little variation in output), and so more reliable processes, which enable to perform a better service with lower costs.

A systematic approach to operational excellence brings service excellence under control without losing sight of organizational efficiency. In fact it gets costs under control both in the hard phase, in which they are highlighted in the 3rd BB to understand possible elements or processes synergies to reduce total costs, and in the soft phase, in which costs are decreased with autonomous maintenance.

And this systematic approach helps to make more efficient a hotel structure whichever is the phase in which hotel life cycle is (process re-engineering phase, reorganization or restructuring phase, planning phase of a new structure).

It helps to increase value perceived by a customer, matching expectation with service, the supplied with the perceived. But it also helps to grow perceived service value adding to the service itself a "human factor", coming from employee empowerment through TPM and a direct contact between the customer and the employee owning each service part or facility. This "human factor" becomes more relevant whenever service has an impact on the private sphere.

Finally the systematic approach helps organizations to focus their attention on their most important resource, that is employees, every single employee, becoming a basis for an engaging environment, a starting point for higher level of employee performance and so for higher organizational performance. In fact higher organizational performance can be achieved not only (or sometimes not at all) through the increase of resources (and therefore costs), but also through letting employees know how important they are to the success of the business, giving them the opportunity to contribute, and helping them believe that their job is important. In one word, giving them a vision, engaging them.

Future developments

The systematic approach developed is now in its test phase. For the future it can be seen as the first step in a service sector, in particular in hotel service, for the achievement of an operational excellence culture.

The author hypothesize that, as it has happened in the industrial sector, also in the service sector as the level of consciousness and competence of management and workers increases, total quality tools and principles (QFD, TPM,…) can easily evolve towards a six sigma philosophy, a "service six sigma".

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The Way from Quality Management System to the National Quality Award

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KEYWORDS: Quality Management System, Self-assessment, EFQM Excellence Model, National Quality Award

Category: *Case study*

ABSTRACT

VŠB – Technical University of Ostrava (VSB-TUO) is the first and till now the only public university in Czech Republic that is certified according to ISO 9001. One of faculties of VSB -TUO, Faculty of Mechanical Engineering was awarded by Czech Republic National Quality Award 2007 in the category public sector. The contribution describes the way of VSB – TUO from implementation of quality management system to implementation of EFQM Excellence Model as step beyond ISO 9001certification.

1. INTRODUCTION

Currently the universities are situated at **competitive environment**. It is the principal reason why they have to identify as the organisations providing the services that satisfy theirs customers.
They provide:

- the university level education,
- R&D
- the cooperation with business and public sector

The quality of provided services is the result of quality of processes that are used to secure it. Quality of processes is determined by quality of management of university. If we want to improve the quality of services provided by university, we have to start with improving the quality of university management. To lead and operate an organization successfully, it is necessary to manage it in a systematic and visible manner. It was the reason, that we decided at VSB- TUO to implement QMS as inherent part of university management.

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2. VSB – TECHNICAL UNIVERSITY OF OSTRAVA.

More than 150 years history of VSB – TUO is closely connected with the development of mining and metal extraction, which was the oldest industry in the Austro-Hungarian Empire. That is why the Emperor Frantz Josef I. decreed (1849) that a mining vocational school be set up in Příbram for the northern countries, and another in Leoben for the southern countries of the Empire. In 1904, the Příbram Academy was given the status of University – Vysoká škola báňská (VSB). The President of the Czechoslovakia, E. Beneš, issued a decree No. 49 on 8th September 1945 by which the university was moved from Příbram to Ostrava. This ended the history of Příbram and opened a new era in the history of the university in Ostrava, the centre of a widespread chemistry, heavy engineering and mining region.

The 17th November 1989 was a historic event in the life of Czech universities and in the whole society. Significant changes have been made at VSB – TUO. The reorganisation of all courses and the new provision of modern branches of study transferred VSB –TUO to a modern polytechnic university.

VSB –-TUO currently consists of seven faculties:

- Faculty of Economics,
- Faculty of Civil Engineering
- Faculty of Mechanical Engineering
- Faculty of Electrical Engineering and Computer Science
- Faculty of Mining and Geology
- Faculty of Metallurgy and Material Engineering
- Faculty of Safety Engineering.

There are more than 22 000 students in bachelor degree, master degree and doctoral degree programmes in daytime, distance and combined studies.

3. IMPLEMENTATION OF QUALITY MANAGEMENT SYSTEM AT VSB – TECHNICAL UNIVERSITY OF OSTRAVA.

Currently there are two basic concepts of QMS:

- the concept of ISO 9000
- the concept of TQM.

The concept of ISO 9000 is the holistic prescriptive approach based on International standards ISO 9000 series. These standards define what is necessary to do (ISO 9001) and how to do the things (ISO 9004).

The concept of TQM is a non prescriptive approach, more or less a philosophy. TQM is applied according to different models that enable to evaluate the maturity of management system in the organisation. EFQM Model Excellence is used in Europe.

After revision of ISO 9000 series at 2000 we can observe the convergence of both concepts. The both of them are now based on more or less similar principles as you can see at Table I.

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Table I – The comparison of principles of ISO 9000:2000 and TQM

ISO 9000:2000 Quality Management Principles	TQM - the EFQM Fundamental Concepts of Excellence
Customer focus	Customer focus
Leadership	Leadership & Constancy of purpose
Involvement of people	People development & involvement
Process approach	Management by processes & facts
System approach to management	Corporate Social Responsibility
Continual improvement	Continuous learning, improvement & innovations
Factual approach to decision making	Results orientations
Mutually beneficial supplier relationship	Partnership development

The existence of explicit defined guidance, which has been successfully many times verified in the industry, led to the decision to implement QMS according to the ISO 9000 concept at VSB - TUO. There are no principal reasons why the benefits of implementation of QMS in industry would differ in the case of the university. The decision to implement QMS according to ISO 9001 was supported by the existence of ISO 9001 registration. The ISO 9001 certificate is outstanding supporting material. It is evidence that proclaims the university is being properly managed, the needs of their customers are identified and the environment to satisfy them is established.

To utilize the good practices from industry the management of VSB–TUO has employed the quality manager that had the long-term experience with QMS implementation and maintenance at the first class manufacturing company that was awarded by the Czech Republic National Quality Award 2001.

VSB-TUO is a huge institution with lot of various activities. The implementation of QMS in whole organisation simultaneously could be risky. The experiences from the implementation of QMS in industry are not fully transmitted into the university environment. There are at least two important differences:
  − The cycle time of product realisation is significantly longer than in industry.
  − The members of university staff and academic freedom.

It was the reason why we split the implementation of QMS into several stages. As each faculty is a relative autonomous part of the university, the first stage (2004) was the implementation of QMS at a selected faculty as a pilot project. This stage was successfully terminated and **Faculty of Electrical Engineering and Computer Science was the first faculty in the Czech Republic that received the ISO 9001 certificate**.

The experiences from pilot project were used during second stage (2005-2006), implementation of QMS at next faculties with utilisation of the experiences from first stage. Final third stage (2007) was the implementation of QMS at the administration and executive part of whole university.

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Each stage consisted of two phases:
- The preparation phase
- The implementation phase

The preparation phase included 5 steps:
1. The decision of faculty/university management about implementation of QMS
2. The declaration of mission , vision and strategy (quality policy)
3. The definition of project team for implementation of QMS
4. The definition of terms
5. The allocation of resources (financial, HR, …)

The declaration of vision, mission and quality policy was fundamental step. They were formulated by management of faculty/university and communicated. To reach the commitment of staff, the discussion on the meetings proceeded. The commitment to quality policy was the base for definition of quality goals on the faculty or university level. The quality goals were subsequently disseminated to department level and linked with personnel goals.

The implementation phase consisted of 7 steps:
1. The training the staff about QMS
2. The implementation of process approach. It consist of :
    a. *Identification of processes and definition of the process map*
    b. *Definition and documentation of processes*
    c. *Definition of process performance criteria*
3. The comparison of existing state   with ISO 9001 requirements
4. The implementation so far missing procedures (control of documents and records, internal audits, correctives action, preventive actions)
5. The assessments of process performance and quality system review
6. The implementation of actions to improve the system performance
7. The certification of QMS.

Processes at the faculty level were divided into three basic groups:
- Customer related processes (education – bachelor, master and doctoral level, R&D activities, and cooperation with business and public sector)
- Managing processes (strategy management of faculty, operational management of faculty)
- Supporting processes (support of education process, support of R&D, purchasing, control of information system.)

There are different **processes at university level**. The faculties are looked as the internal customers of university. It means the university supports the faculties. The main, customer orientated processes from the point of view of university, are processes of resource management:
- finance management
- facility management
- HR management
- IT management

These resource management processes are executed and controlled by force of strategic management and operational management processes at the university level.

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The descriptions of all existing processes and implementations of ISO 9001 required procedures were followed by assessments of the process performance through the defined process performance criteria. These process performance measurements were completed by customer satisfaction measurements. We evaluated the satisfaction of:

- students during their study at the university,
- students after some years of their professional career
- employers with graduate's skills
- business and public sector partners

These measurements were, together with internal audits findings, the bases for analysis. The results of analysis defined area for improvement.

4. THE WAY TO EXCELLENCE

The ISO 9001 approach is focused to the customer needs. The university management system has to be oriented not only to their customers but also to their stakeholders (interested parties) – TQM approach. The ISO 9004 offers the guidance for performance improvements by including the needs of stakeholders. Both of the standards, ISO 9001 and 9004, do not offer the powerful instrument for evaluation of maturity of management system. Therefore we were looking for some efficient instruments for university management system assessment, which can describe the university life more complex. Because we are from the beginning of the management improvement focused to the use of industrial standards, it is not surprising, that we choose very complex industrial quality assessment system based on the EFQM Excellence Model (EFQM, 2003), see Figure 1. This model was also rearranged for education institutions (Centre for Integral Excellence Sheffield Hallam University, 2003), (TRIS-EFQM, 2003).
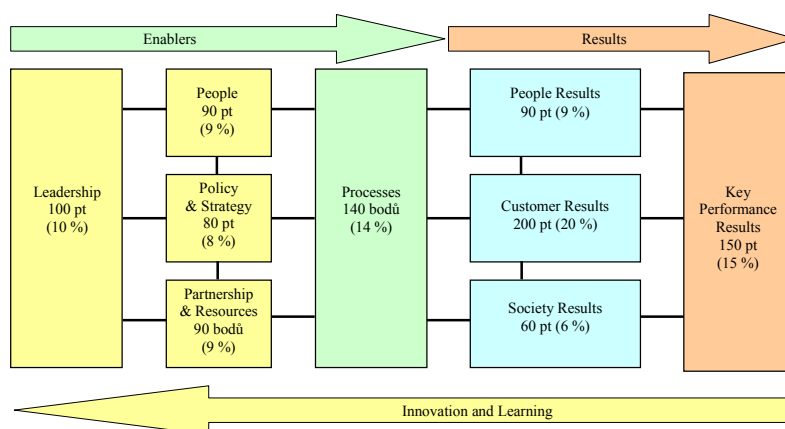

Figure 1 – EFQM Excellence Model (EFQM, 2003)

The progress of implementation of TQM approach at the VSB-TUO was the nearly the same as in the case of implementation of QMS according to ISO 9000. We have started at selected faculty as a pilot project and we continue at next faculties with utilizations of the experiences from pilot stage.

Significant motivation for orientation to the complex quality comprehension was the Program of the Czech Republic National Quality Award, which was in year 2006 opened for non-profit organization and extended by two categories – based on the CAF Model and based on the EFQM Model Excellence.

Faculty of Mechanical Engineering was the pilot faculty where we started with implementation of TQM philosophy. This faculty applies into the Program of the Czech Republic National Quality Award 2006 - part assessment based on EFQM Model Excellence.

Many analyses were done during the self-assessment process. The most significant weaknesses and threads were selected, analysed and activities to their removal was run very fast. Many uncertainties were eliminated by new analyses by questionnaires for graduates, new students and unsuccessful students. Many external analytical projects were joined and supported, like REFLEX focused to the students graduated in the past three years, graduate employability, students assessment project realized by the ACSA – Academic Centre of Students Activities in the same time at all universities in the Czech Republic. The next important area which was omitted in the past time was collaboration with suppliers; especially it means collaboration with the high schools. Project called "Partnership with high schools" was started on the end of year 2006 by the concrete offers for their study support like special excursions to the faculty labs, university teachers lectures focused to actual technical problems and news and other real collaboration support.

Based on evaluation of self-assessment report, followed by site visit of assessors, the Faculty of Mechanical Engineering was awarded by - "Recognised for Excellence-2006" level. The feedback from site visit was recognised very useful. Other possibilities for improvement were identified.

The next step was dissemination of TQM approach at Faculty of Economics and Faculty of Mining and Geology. Faculty of Mechanical Engineering and Faculty of Mining and Geology apply into the Program of the Czech Republic National Quality Award 2007 - part assessment based on EFQM Model Excellence and were successful. Faculty of Mining and Geology was awarded by - "Recognised for Excellence-2007" and **Faculty of Mechanical Engineering become " Award –winer 2007 – category public sector** ". It was the first time the university was awarded by this prestigious award.

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Fig.2. The representatives of VSB–TUO are awarded by Czech Republic National Quality Award 2007 at Spanish hall of Prague Castle.

The experiences with implementation of QMS at university environment are recognised very interesting also for all other universities. The main outcomes were presented at the International conference Principia Cybernetica (Farana, 2005), International Conference on Engineering Education (Farana, 2006) and 7st International Conference of Quality Managers (Hutyra, 2006)

6. SUMARY.

The implemented QMS brings the benefits both to customers and stakeholders of the university (students, employers, society), and to university itself. The results of the implemented TQM approach at the VSB-TUO and participation in the Program of the Czech Republic National Quality Award are very positive. The orientation to the complex quality improved the university life, their processes and efficiency.

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Attractive Quality Creation: A Case Study of Microwave Ovens

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Originality/value

Empirical research on attractive quality creation is sparse and this study represents a rare example of a comprehensive study of attractive quality creation.

Purpose

The purpose of this study is to present a case study of attractive quality creation on microwave ovens and try to identify the characteristics of attractive quality attributes.

Design/methodology/approach

We involved 30 customers of a company designing and producing microwave ovens. In a number of experiments these customers generated over 100 new ideas on functions, attributes and services related to microwave ovens. The 21 best ideas were identified by company specialists and these ideas were then evaluated by a large customer group using the theory of attractive quality in order to identify what ideas that are really examples of attractive quality attributes.

Findings

Our study shows how the theory of attractive quality can be used in the development of new products and services. We also provide empirical evidence on the characteristics of attractive quality attributes.

Keywords: Attractive quality creation, customer idea generation, Kano.
Categorization: Research paper.

Introduction

Inspired by Herzberg's Motivator-Hygiene Theory (Herzberg, 1966), Professor Kano and his co-workers developed the theory of attractive quality (Kano et al., 1984). It is a theory intended to better understand different aspects of how customers evaluate and perceive quality attributes. It explains how the relationship between the degree of sufficiency and customer satisfaction with a quality attribute can be classified into five categories of perceived quality. Using a specific questionnaire, quality attributes can be classified into one of five quality dimensions: (i) attractive; (ii) one-dimensional; (iii) must-be; (iv) indifferent; and (v) reverse (see e.g., Kano et al., 1984; Berger et al., 1993; Löfgren and Witell 2005). The first of these quality dimensions, attractive quality, refers to attributes that often surprise and delight customers. These attributes are used for the purpose of raising customer satisfaction but when not fulfilled customer *dis*satisfaction is not affected. In a literature review of how Kano's theory of attractive quality has been used and interpreted in academic papers over the past two decades, Löfgren and Witell (2008) found a lack of empirical research on attractive quality creation. Therefore, the focus in this paper is on just that: attractive quality creation. We define attractive quality creation as the creation of a useful product with attractive quality attributes that does not exist in the market.

Attractive quality creation has been relatively neglected as quality specialists have tended to focus on elimination of things gone wrong, i.e., must-be quality (Yamada, 1998; Kano, 2001). The theory of attractive quality can be used in two ways to address this imbalance—(i) as a conceptual model of what constitutes 'attractive' quality; and/or (ii) as a survey methodology to ascertain how customers perceive ideas for new features, functions, and products. New ideas trigger the innovation process and the development of new products. Unfortunately, only a very small percentage of the initial ideas for new products eventually lead to commercial success. To be able to use attractive quality creation to develop innovative products, the methodology is dependent on an idea bank with ideas that are original and can create customer value. Yamada (1998) has suggested combining the Kano methodology with creativity techniques to enhance the generation of ideas. We suggest an alternative approach where customers are actively involved in the idea generation process by coming up with new innovative ideas. These customer generated ideas can then be used and classified by larger customer groups in a survey following the theory of attractive quality.

The purpose of our study is to investigate if and how new ideas generated by customers can be used in a process of attractive quality creation. First, we involved 30 customers in the idea generation process of a company designing and producing microwave ovens. In a number of experiments these customers generated about 100 new ideas on functions, attributes, and services related to microwave ovens. The 21 best ideas were identified by company specialists and these ideas were then evaluated by a large customer group in a Kano survey. The specific purpose of that survey was to identify ideas that posses the qualities of attractive quality. The study at hand shows how methods for idea generation and the theory of attractive quality can be used jointly in the development of new products and services. We provide the outline of a process and methodology for

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identifying and verifying brand new attractive quality attributes. In the next section of the paper the case study is described in detail.

A Case Study of Involving Customers in Attractive Quality Creation

In this research project we worked together with a manufacturer of microwave ovens. For the market of microwave ovens each manufacturer sells their different products under a range of different brands, ranging from low-priced ovens with few functions to high-end ovens with a lot of functions. Both the technology and the market are mature and there is an interest for manufacturers to identify new ways of delivering customer value.

The early phases of the product development process often include a phase of idea generation. In this case, idea generation consists of four main activities: *Generation*, *Screening*, *Identification*, and *Evaluation*, see Figure 1. To build on previous research that claim that customers have the ability to come up with more innovative ideas than product developers do (Kristensson et al., 2004), customers were invited to participate in the activities of generation and identification of ideas. The first activity was idea generation by customers with the purpose of coming up with innovative ideas. In the second activity, company screening of ideas, engineers and marketers made a preliminary screening to identify the ideas with the most innovative potential. Then in the activity customer identification of attractive ideas, these ideas were evaluated by customers using the theory of attractive quality. In the last activity, company evaluation of ideas, the product developers went through all the performed analyses and together with other information, such as technological and financial, a decision was made on what ideas to develop further.
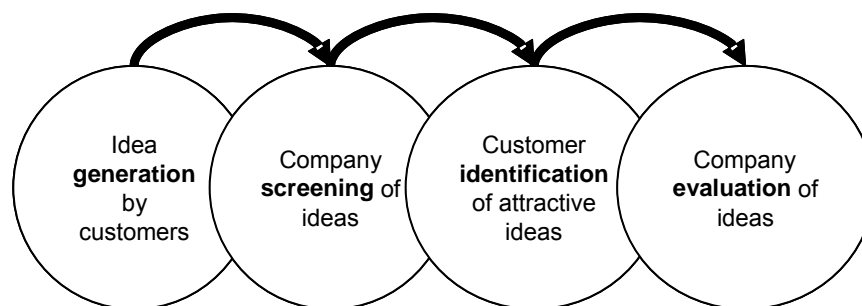
Figure 1: A process for including customer idea generation in attractive quality creation.

Idea Generation by Customers

The importance of finding potentially successful ideas is well-known, but nevertheless many companies do not take action to assure that every source of ideas is used. Companies often obtain information about customer needs only, and assign manufacturers with the task of generating ideas for solutions leading to new products (Lilien et al., 2003). Company employees are required to translate needs into solutions that should fit these needs. It can be argued that engineers can have it hard to come up

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with ideas on new products and services that will be attractive to customers. In a recent study of idea generation in the telecommunication industry, Magnusson et al. (2003) show that customers come up with ideas with a higher degree of innovativeness than the engineers employed by the company. In addition, their studies show that for mobile telephone services the average customers are better at coming up with ideas than lead users are and that the average customers that have gotten training by engineers come up with less innovative ideas. To conclude, a plausible strategy is to involve average customers in the phase of idea generation in the development process.

To be able to get customers to generate new ideas on functions, services, and features related to microwave ovens, customers got access to a new microwave that was not yet available in stores. In addition, the customers got a bag including instructions on how to use the microwave, a camera, a diary, a questionnaire of their microwave oven usage, a bag of popcorn, a cake to bake in the microwave, and a list of some web sites to visit. Customers were supposed to use the new microwave oven for a week and during this time write a diary over how they used the oven. Each time a customer got an idea related to how to buy, use, or dispose a microwave oven the customer was supposed to write down this idea in a specific section of the diary. The customer was supposed to name the idea, describe the essence of the idea, and list the benefits of the idea. At the end of the week, the microwave ovens, the questionnaire, and the diaries were collected and the customers were given cinema tickets as a token of our appreciation.

In total, 30 customers were enabled to use the new microwave ovens for a week. During this period, the customers generated 108 ideas related to microwave ovens. Each customer came up with 1 to 15 new ideas. Examples on new ideas were for instance the self-cleaning microwave oven, i.e., a microwave oven that has a button for self-cleaning so that the microwave becomes perfectly clean without having to scrub it. Some of the ideas where very novel, while others had been tried before or existed on the market.

Company Screening of Ideas

All the ideas collected in the diaries were transcribed and put together in an idea book. This bok contained all the ideas, which were grouped together so similar ideas were next to eachother. An idea session was conducted with a research team and eight product developers at the manufacturer. Each product developer was to go through the ideas and judge them on a scale (1 to 10) on how original the idea was and to what extent the idea provided customer value. On an overall level, the originality of the ideas ranged from 4.1 to 8.75 while the customer value ranged from 1.25 to 9.25.

The preliminary evaluation of ideas resulted in a list of the 21 most promising ideas (see Table 1). This classification was not only based on the degree of originality and customer value, but also to some extent on the possibility of implementation during the coming decade. Using, the scoring of ideas of the different judges an orginality and value index was calculated. This resulted in a list of the most promising ideas that was of interest to get some customer input on.

Customer Identification of Attractive Ideas

To get customer input on the most promising, and to identify attractive ideas, a Kano questionnaire was used. The questionnaire contains pairs of customer requirement questions, i.e., for each customer requirement two questions are asked (Kano et al., 1984; Berger et al., 1993). In answering each form of the question, the customer is required to choose one of five alternatives. Responses to both the 'functional' and 'dysfunctional' forms of the question are required for the classification of customer requirements. The classification is then made using an evaluation table in which each customer requirement can be classified into one of five dimensions: 'attractive', 'one-dimensional', 'must-be', 'reverse', and 'indifferent quality' (for a detailed description of classification of quality attributes, see Witell and Löfgren, 2007). Finally the responses for each customer requirement were tabulated. In attractive quality creation where the focus is on ideas that do not exist in the market and that the customer has not experienced before the aim of the Kano methodology is to identify the ideas that are attractive to customers.

In the survey, the 21 most promising customer ideas were tested. The questionnaire consisted of three parts. The first section included questions regarding customers' usage of microwave ovens. Then a section with questions based on the theory of attractive followed, and last, a section where the customer judged the value of the different ideas. In total, 87 young adults participated in the study. An overview of how the results were classified is presented in Table I.

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Table I: Classification of customer ideas into quality dimensions.

Customer Idea	Short Description	Agreement	CS	Classification (CS 15%)	Customer value	Originality
Micro-Bag	*A portable microwave oven*	0,75	0,56	Indifferent	3,16	8,75
Voice-Pitch	*The microwave oven is controlled by speech*	0,48	0,11	Indifferent	4,17	4,50
Heat & Freeze	*The microwave oven can work as a quick cooler.*	0,57	0,22	Attractive	5,05	5,50
Fridge-Micro	*The microwave oven works as a refrigerator when not used to cook.*	0,53	0,28	Indifferent	3,39	5,75
Do-it-Everywhere	*The lunchbox has a microwave effect in the lid.*	0,75	0,55	Attractive	5,45	8,00
Make and Bake	*The microwave oven mixes, stirs and cook the ingredients into a meal.*	0,43	0,08	Combination (Attractive & Indifferent)	3,98	5,50
Parents-in-the-lake	*A portable and battery driven microwave oven.*	0,48	0,06	Combination (Indifferent & Attractive)	3,43	6,50
Micro-Dry	*The microwave oven can be used to dry clothes.*	0,41	0,01	Combination (Reverse & Indifferent)	2,26	4,50
Micro-Receipt	*The microwave oven can be used to download receipt from the Internet.*	0,48	0,03	Combination (Attractive & Indifferent)	3,55	7,00
Freeze Meat	*Special boxes to freeze food in that are made for microwave ovens.*	0,66	0,37	Indifferent	3,68	5,33
Sense	*The microwave oven can sense what food it is and choose program by itself.*	0,83	0,72	Attractive	8,26	8,50
SelfClean	*A microwave oven that cleans itself on the inside after usage.*	0,79	0,66	Attractive	8,57	8,75
Perfect Temp	*Can choose temperature on the cooked food.*	0,61	0,45	Attractive	8,29	8,50
Easy	*A microwave oven that has many functions but is very easy to use.*	0,68	0,49	One-dimensional	9,03	8,50
EasyClean	*The microwave oven is easy to clean*	0,71	0,57	One-dimensional	9,10	6,75
Sensoria Amoria	*A microwave that stops when milk or porridge starts to come over the sides of the plate.*	0,66	0,39	Attractive	8,09	7,75
PopStop	*A microwave that stops when the popcorns are ready.*	0,78	0,59	Attractive	8,15	7,75
Customize	*A microwave oven where customized programs can be created.*	0,55	0,14	Combination (Indifferent & Attractive)	5,21	6,50
ReadySense	*The microwave can sense when the food is ready.*	0,78	0,67	Attractive	8,37	8,75
NoStart	*The microwave oven can not start if not everything is in the right place.*	0,39	0,06	Combination (Indifferent & Reverse)	4,80	8,00
Sequence	*A microwave oven that works as a sequential cookbook.*	0,68	0,44	Indifferent	3,51	7,50

In Table I, agreement represents the percentage of the respondents who have agreed on the final classification and CS stands for category strength, i.e., the percent difference of the highest category above the next-highest category (Lee and Newcomb, 1997). Lee and Newcomb (1997) suggest that the category strength should be at least 6 percent when you have a large sample. Since our sample size is only 87 respondents, we chose to set the category strength to 15 percent. In total, 8 attributes were classified as 'attractive', 6 as 'combinations', 5 as 'indifferent', and 2 as 'one-dimensional'.

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Since the purpose of the study is to identify the ideas that possess attractive quality attributes and that possibly should be included in future products, our main interest concerns the ideas that are attractive. We find it notable that six of eight attractive quality ideas score 8+ in stated customer value and that seven of the same ideas got originality scores in the range of 7.75-8.75 from the company experts. To get an overview of all ideas we plotted all the ideas in a Better-Worse diagram (Berger et al., 1993), see Figure 2. In the calculation formula below, each quality dimension is represented by its first letter, e.g., 'A' stands for 'attractive quality'.

$$\text{Better} = \frac{A+O}{A+O+M+I} \qquad \text{Worse} = -\frac{O+M}{A+O+M+I}$$

The positive better numbers indicate that customer satisfaction will be increased by providing a quality attribute and the negative worse numbers indicate that customer satisfaction is decreased by not providing a quality attribute (Berger et al., 1993). For the purpose of clarity, all numbers have been made positive in Figure 2.
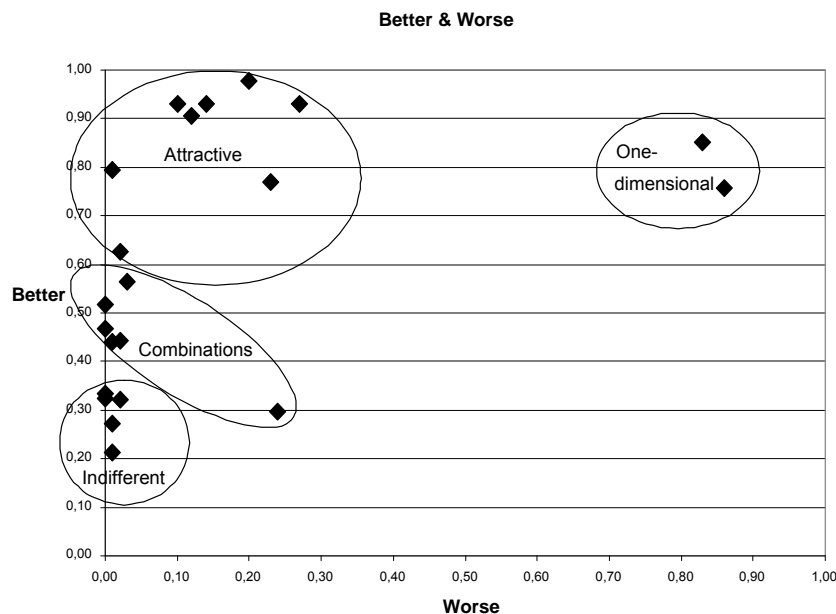

Figure 2: An overview of the customer ideas in a Better-Worse diagram.

Going through the classification of ideas and the Better-Worse diagram, it is revealed that there are 8 ideas that have been classified as attractive. These ideas cover areas such as the microwave ovens ability to make food colder, to stop when the food overcooks, the food or popcorn are ready, to sense what food is in the oven and choose program thereafter, to clean itself after use, the ability to cook the food to a specific temperature, and an idea that puts a micro-effect in the lid of a lunch box. All these ideas have the potential to delight the customers if included in future generations of microwave ovens. But not all ideas should be chosen to be developed further. By using additional information the company needs to prioritize among the ideas with the highest potential.

Company Evaluation of Ideas

In the last activity of idea generation, the company needs to evaluate the ideas with the most potential. For these ideas more information is needed on what is technical feasible, what the market potential is, and what the financial consequences might be. As an illustration of information that can be used, the perceived customer value of all ideas is provided in Figure 3. Here, two views of the customer perceived value are provided. First, the value of all ideas as judged by the customer and second, the customer perceived value as judged by the company. As can be seen, the two views agree on the value of 9 ideas. In one case, the customers have a much higher perception of the value than the developers do. But in general, the company has an over belief in the customer perceived value of the ideas. In addition, not all product ideas lead to action. In the end, the company should choose some of the attractive ideas to develop further.
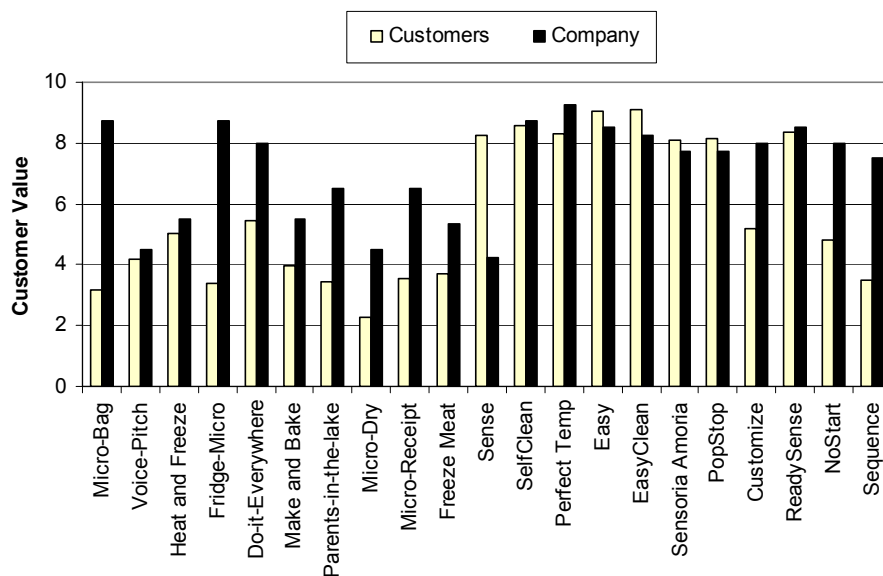
Figure 3: Comparisons customers' and the company's stated customer value of the different ideas.

Similarities and Differences between Different Quality Dimensions

The sparse research on attractive quality creation provides us with no guidance on if the theory of attractive quality can be used to actually separate between different kinds of attributes early in the development process. To be an alternative for companies, attractive quality creation needs to be able to pinpoint those attributes that are more original and provide more customer value and this has to be done before the attribute is implemented in an actual product.

To test this we decided to make a comparison between the different kinds of attributes identified in our empirical investigation. We divided the attributes to enable a comparison between the 8 attractive attributes, the 11 indifferent or combinations of attributes and the 2 one-dimensional attributes. T-tests were performed to compare the customer value

originality of attractive quality attributes with the two other kinds of attributes identified in our study. Our results show that attractive quality attributes are more original and provide more customer value than the indifferent attributes do. In addition, the one-dimensional attributes are perceived as providing more customer value, while no difference can be identified concerning originality.

Table II: Comparisons between quality dimensions.

Classification	Attractive (A)	Indifferent (I)	One-dimensional (O)	A-I	A-O
Customer Value	7,53	3,74	9,07	p < 0.01	p < 0.05
Originality	7,94	6,35	7,63	p < 0.05	p > 0.05

Note: The sample sizes for the observations are limited.

Our results show that the ideas that have been identified as attractive are more original and provide more customer value in comparison to the ideas that have been pointed out as indifferent. This follows the logic of the life-cycle of quality attributes (Kano, 2001). This logic also explains that we can find certain indifferent ideas that score high on originality, since some of these attributes might become attractive over time. Following a similar reasoning it is logical that the ideas identified as one-dimensional provide higher customer value in comparison to the ideas identified as attractive. No difference can be found concerning the originality of the attractive and the one-dimensional ideas. We should expect that the attractive ideas are more original than the one-dimensional ideas. However, the sample size of our study is limited and our results should be interpreted with caution.

Discussion and Implications for Attractive Quality Creation

In this paper, we have investigated if customer generated ideas can be used in attractive quality creation. Successful idea generation is one of the most important activities in attractive quality creation, and since customers have been identified as a source of innovative ideas it is fruitful to combine idea generation by customers with attractive quality creation. Our case study of microwave ovens show that the four main activities of idea generation (Generation, Screening, Identification, and Evaluation) works well as a framework to guide the involvement of customers in certain activities of the process.

Attractive quality attributes are often referred to as 'surprise' or 'delight' attributes (see e.g. Matzler et al., 1996; Watson 2003). As a result of the idea generation process, our case company has a number of attractive ideas that has the potential to delight customers. In addition, when these ideas were evaluated by company experts, it was revealed that the attractive ideas also scored high on originality. To a layman some of the originality scores shown in Table I may seem strange. For instance the 'Voice-Pitch' idea, about controlling the microwave oven by speech, only scored 4.5 on ten-point scale. However, after discussing with the company experts that made the originality evaluation, it was made clear that some of the ideas already had been tried by different microwave oven manufacturers. This explains why some of the ideas that seem novel to the public are not viewed the same way by company experts. It also strengthens the methodological choice

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made in this paper to use company experts and not customers when evaluating originality.

Our results show that the operalization of the theory of attractive quality can aid a company in pointing out those attributes that provide higher customer value and that are more original than other attributes. This is an important finding since it enables an organization to estimate the originality and the provided customer value before the attribute has been built into a product.

Research on attractive quality creation has this far been sparse. Lilja and Wiklund (2006) have identified two obstacles to the creation of attractive quality: (i) the diversity of meanings given to the concept of 'attractive quality'; and (ii) a lack of explanations of the occurrence of attractive quality. The authors argued that these two obstacles have led to misunderstandings and mismanagement of attractive quality creation. We would also like to add the lack of empirical research focusing on attractive quality creation as a third obstacle. We feel that it is time to address these issues and put emphasis on innovation within the quality movement and that this paper is a first step in that direction. The main managerial implication to be learnt from our research is that ordinary customers can be used for generating original ideas in attractive quality creation.

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Breaking the Customer Code
A Model to Translate Customer Expectations
into Specification Limits

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Abstract

Purpose – The aim of this paper is to develop a model to help service organizations to set the specification limits according to the customer expectations.

Design/methodology/approach - A review of relevant literature is used to develop a new integrated model with ideas from the Kano model, SERVQUAL, Taguchi loss function, Importance Performance Analysis (IPA) and a new model, "the Trade-Off Importance". A survey was carried out for 18 external customers and internal stakeholders of the Service Division of Siemens Industrial Turbomachinery AB in Finspong, Sweden.

Findings – The model has demonstrated its robustness and credibility to set the specification limits. Additionally it is a very powerful tool to set the strategic directions and for service quality measurement.

Research limitations – First, articles published on this subject are few and there is no similar model in the literature to confirm or compare results. The proposed model must be further validated in future research. Second, this study is applied in a single service division, with a relatively small sample. Ideal research should be conducted using multiple industries in order to ensure that the model is generalizable.

Originality/value – As far as we know, this paper is the first attempt to create a roadmap to set the specification limits in services. Researchers should find the proposed model to fill the research gap. From a managerial standpoint, the practical benefits in Siemens Industrial Turbomachinery AB, suggest a new way of communicating to customers. The model will also improve the target setting in the Six Sigma projects.

Keywords Customer satisfaction, Service industries, Six Sigma, Specification limits, Kano model, SPC

Paper type Research paper

Introduction

During the last 20 years, there has been steady growth not only in the service sector but also in the service content of most products (Nilsson, 2002). Today some 70% of the GNP is derived from the service sector in the US and most European countries (Bergman and Klefsjö, 2003). Research scholars suggest that firms now compete with services rather than goods (Rust, 1998; Grönroos, 2000; Vargo and Lusch, 2004). Harris and Harrington, (2000) claim that that the opportunity area for the twenty-first century is in the understanding and improvement of the service processes putting the customer in the centre of the issue. Phillips-Donaldson, (2005) in the article *"The Rock Stars of Quality"* states that the next breakthrough –and rock star (referring to the next guru in quality management)- is likely to come from the service sector.

The well-published financial benefits of Six Sigma in manufacturing are beginning to energize large scale application in services (Antony,

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2006). Reported case studies of Six Sigma in services are scattered in a wide range of publications e.g. Cronemyr, (2007). Six Sigma is being used in banking, healthcare, accounting and finance, public utilities, shipping and transportation, airline industry, education (Antony, 2006).

An important part of the Six Sigma methodology is the calculation of number of defects in the process, i.e. points outside the specification limits. However, unlike goods quality, which can be measured objectively by number of defects, in service processes the setting up of specification limits is a complicated issue because it is marked by the use and expectations among the different customers. As Six Sigma was originally created for manufacturing, this crucial fact is not contemplated in the Six-Sigma roadmap Define- Measure-Analyze-Improve-Control (DMAIC).

Walter A. Shewhart viewed quality from two related perspectives: the objective and subjective side of quality (Shewhart, 1931). The first perspective views quality as an objective reality independent of the existence of man. In contrast, the subjective side of quality considers what we think, feel and sense as result of the objective quality.

Despite differences in expression, the two aspects of subjectivity and objectivity have revolved around since the time of Aristotle, (350BC) (Kano et al., 1984), and some popular models are widely used both by academics and practitioners, to link these two sides e.g. the Kano model, Quality Function Deployment, Puga-Leal and Pereira, (2007) model, classification through direct questions, Importance Performance Analysis, Kansei engineering, conjoint experiments. However, none of these approaches serve to successfully transform the customer expectations into specification limits in services.

This paper aims resolve this issue developing a roadmap to systematically set the specification limits in services linking the subjective side of quality with the objective side. To do so, one integrated model is presented, combining ideas from the Kano model, SERVQUAL, Taguchi loss function, Importance Performance Analysis (IPA) and a new model, the Trade-Off importance. The following section briefly reviews these five methods.

Kano model

Kano et al. (1984) developed a model to categorize the attributes of a product or service based on how well they are able to meet customer needs. The following are the popularly called Kano customer need categories.

- *Must-be requirements*: If these requirements are not fulfilled, the customer will be extremely dissatisfied. On the other hand, as the customer takes these requirements for granted, their fulfillment will not increase his satisfaction.

- *One-dimensional requirements*: With regard to these requirements, customer satisfaction is proportional to the level of fulfillment - the higher the level of fulfillment, the higher the customer's satisfaction and vice versa.

- *Attractive requirements*: Also called Whoh! or delighters, these requirements are the product criteria which have the greatest influence on how satisfied a customer will be with a given product. Attractive

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requirements are neither explicitly expressed nor expected by the customer. Fulfilling these requirements leads to more than proportional satisfaction. If they are not met, however, there is no feeling of dissatisfaction.
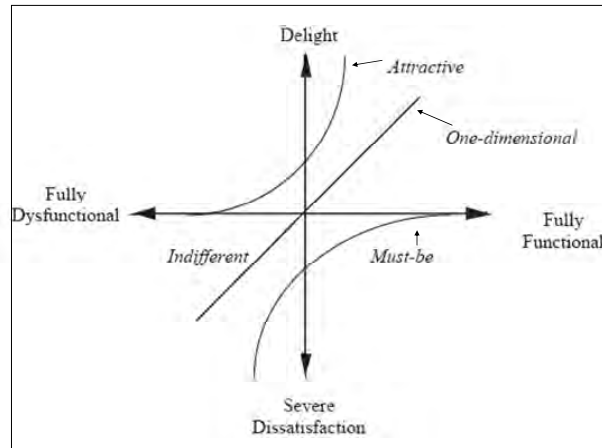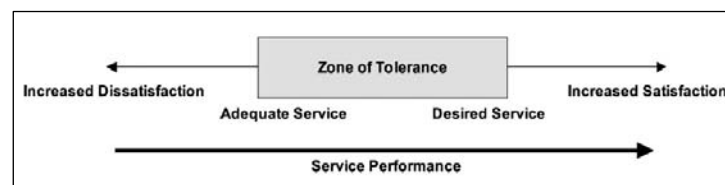

Figure 1.
Kano model of customer satisfaction.
Source: Pouliot, (1993)

SERVQUAL

In 1985, Parasuraman et al. developed the SERVQUAL instrument (refined in 1988, 1991 and again in 1994). The instrument consists of two sets of 22 statements: the first set aims to determine a customer's expectations of a service firm; while the second set seeks to ascertain the customer's perceptions of the firm's performance. The results of the survey are then used to identify positive and negative gaps in the firm's performance on five service quality dimensions. (Robison, 1999) According to Robison, 1999, there seems little doubt that in the past decade SERVQUAL has proven to be the most popular instrument for measuring service quality.

Berry and Parasuraman, (1991) defined the zone of tolerance as the range of service performance that a customer considers satisfactory. A performance below the tolerance zone will engender customer frustration and decrease customer loyalty. A performance level above the tolerance zone will pleasantly surprise customers and strengthen their loyalty. Several authors (e.g. Johnston, 1995; Cronin, 2003) consider that levels of service performance within the zone of tolerance are not perceived as different by customers. SERVQUAL 3-column format is capable of specifically indicating the position of the zone of tolerance.


Figure 2. Variations within the zot are not perceived by the customers

Taguchi loss function

Taguchi changed the traditional view, that as long as a parameter lies within the specification limits, the financial loss is zero and as soon as a parameter has exceeded one of the tolerance limits, the financial loss is large. For Taguchi, every deviation from the target value means a loss

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which grows as the deviation increases (Bergman and Klefsjö, 2003). This view puts the customer at the centre of the issue (Lofthouse, 1999).
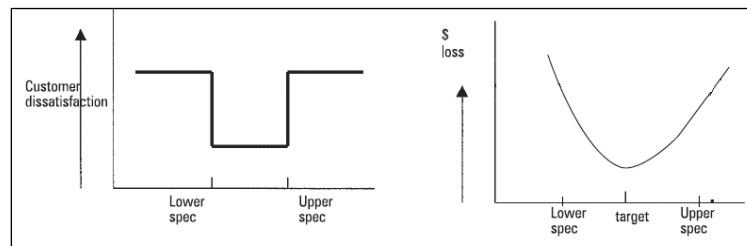
Figure 3. a)traditional view b) Taguchi loss function

For further details see Taguchi, (1987) or Phadke, (1989), for a short general overview with down-to-earth language see Lofthouse, (1999).

The Importance Performance Analysis (IPA)

The Importance Performance Analysis (IPA), introduced originally by Martilla and James (1977), and modified by Slack (1994), allows a company to identify which attributes of its products or services should be improved to become more competitive in the market. Typically, data coming from customer satisfaction surveys are used to build a matrix, where the importance is shown by the y-axis and the performance of the attribute by the x-axis. Although the IPA model of quality attributes has a simple structure, it can provide much useful information about a company's quality performance (Tontini and Silveria, 2007).

The Trade-Off Importance model

In the literature there is an agreement about the necessity of analyzing the relative importance of the attributes (e.g. Deming, 1986; Walker and Baker, 2000). When visiting your doctor, getting the proper diagnosis and treatment seems more essential than having a good selection of magazines available in the waiting room, though both may be necessary for a favorable experience (Walker and Baker, 2000). Customers may consider some features of a service as more necessary or essential to their experience than others.

The customer tends to consider everything important; we call it the "everything is important" problem. We developed a new approach for relative importance measurement, the Importance Trade-Off analysis. The basic idea of the model is that when explicit trade-offs between elements of the customer service mix are taken into account, different components of relatively importance emerge (Wetzels et al., 1995).

The customer is asked three pair wise questions of two attributes (see figure 4) and the questionnaire results are translated into one importance scale from 1 to 10 points. The trade off importance model is able of successfully measure the relative attribute importance.


If everything else would be the same **WHICH WOULD YOU PREFER?**					
INSPECTION REPORT delivery time			MONTHS		
	0,5	1	1,5	2	2,5
	O	O	O	O	O
Spare part DELIVERY after the confirmed date	16	12	8	4	0
			DAYS LATE		

Figure 4. The new model: trade-off importance. One out of three trade-off questions

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Model construction

In the literature there is an agreement about the limitations of using the methods explained previously alone and the need of an integrated approach (e.g. Tan and Pawitra, 2001; Puga-Leal and Pereira, 2007; Yang, 2003).

Witell and Löfgren (2007) made a literature review of 29 research articles; they found that the Kano model is often modified or used in combination with other methods.
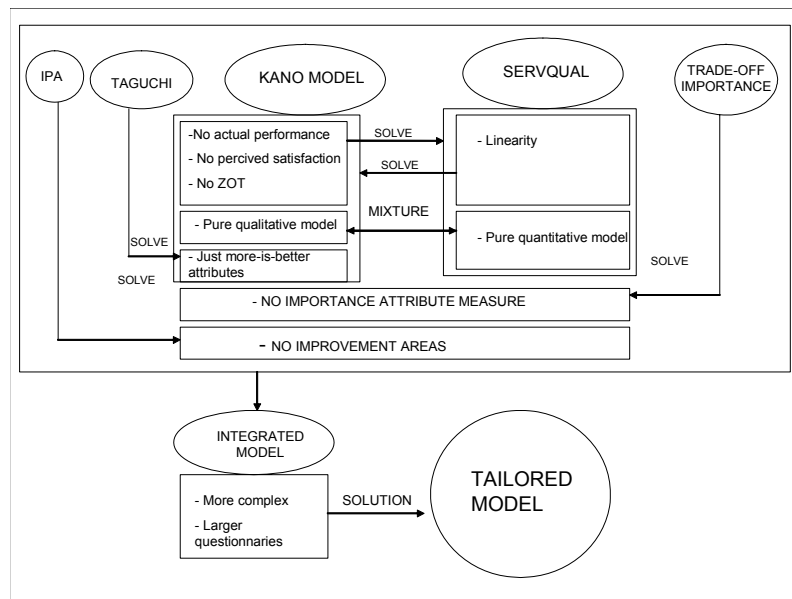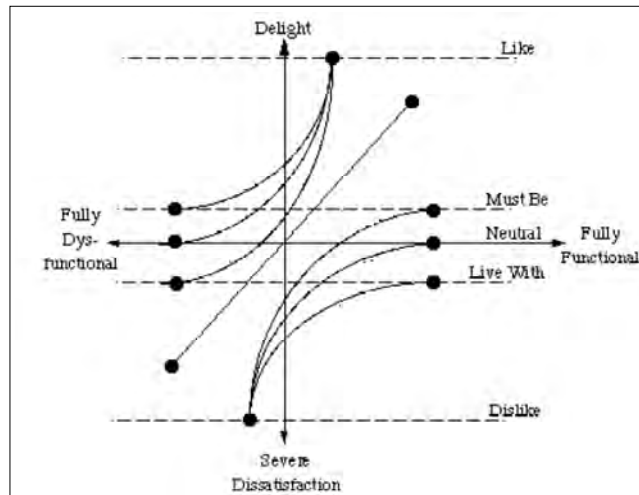

Figure 5. Problem analysis of the different models

Kano model modification and integration in SERVQUAL

The Kano model is a purely qualitative model, it does not inform about the actual situation in the curve, for example, one attribute is classified as "must be" but the model does not give any information whether the current performance is, for example, in the severe dissatisfaction area or in the neutrality area.

To solve this problem it is interesting to introduce the zone of tolerance concept into the Kano model. According to Pouliot, (2003), the "Must be" level is only a little above neutral because Must-be is only a weak statement of satisfaction, it is more a statement of lack of dissatisfaction, though certainly more positive than neutral. Symmetrically, "can live with" is not a strong statement of dissatisfaction, but its grudging acceptance is more negative than neutral.

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Figure 6.
Proposed lines, observe that there is not only one line for every classification. Source: (Pouliot, 1993)

Laveling the vertical levels of the Kano model with the wordings of the answers of the Kano questionnaire and integrating SERVQUAL into the Kano model, in the vertical axis, the area between "It must be like that" and "I can tolerate it" is the satisfactory service level where we can introduce the subjective zone of tolerance.

In the horizontal axis, we introduced the actual performance in, for example, days or months and the plot the box plot from historical data.

The satisfaction-performance lines allow to translate the subjective zone of tolerance to the objective zone of tolerance. It allows to know the percentage of the points of the service offered that fall into the satisfaction, dissatisfaction or delight area.

Despite SERVQUAL's wide use by academics and practitioners in various industries and in different countries, a number of studies have questioned its conceptual and operational bases, (e.g. Morrison, 2004, Lewis and Mitchell, 1990, Smith, 1995).

According to Tan and Pawitra (2001), three main areas for further improving SERVQUAL can be identified. First, SERVQUAL assumes that the relationship between customer satisfaction and service attribute is linear i.e. all the attributes are one-dimensional. This is not in line with the Kano ideas. In addition, SERVQUAL is recognized as a continuous improvement tool. There is however, no element for innovation. Third, SERVQUAL provides important information on the gaps between predicted service and perceived service but it is not able to address how the gaps can be closed.

Kano model can help address the innovation issue against SERVQUAL. Because attractive attributes are a source of customer delight, this is one area where efforts for improvement should be targeted (Tan and Pawitra, 2001). Introducing Kano model into SERVQUAL can counter the linearity problem.

Integrating and modifying SERVQUAL and Kano model, some problems have been addressed. However, there still are some more:

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Kano model just considers more-is-better attribute: Taguchi, (1987) considered four categories of quality characteristics: higher-the-better (e.g. computer's performance), lower-the-better (e.g. waiting time in a queue), nominal-is-best (e.g. time schedules) and asymmetric.

The Kano model can be used just with more-is-better attributes. We developed a systematic approach to draw the four categories satisfaction-performance curves without the use of the Kano classification table.

The relative importance of the attributes is not analyzed: Kano model and SERVQUAL do not analyze the relative importance of the attributes. By integrating the new Trade-Off Importance model the information about the relative importance is obtained.

No improvement directions: Kano model and SERVQUAL do not have any strategic direction approach for guiding after the results. The Importance Performance Analysis, with information from the trade off importance model and SERVQUAL together with the Kano classification helps to guide to the improvement directions.
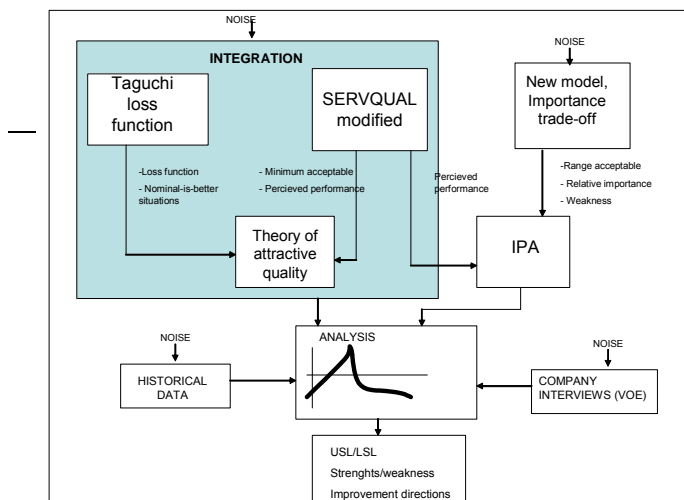
Figure 7.
Proposed model

Application in the Service Division, Siemens Industrial Turbomachinery AB (SIT)

Cronemyr, (2007) developed a model for process management that is being used in SIT AB. According to this approach the first step is mapping processes, second run Six Sigma projects and third go for the process control. Currently, phase 1 and 2 are running successfully, and Phase 3 is not used in the right way. Analysis and follow-up of Key Performance Indicators (KPIs) are performed with bar charts with monthly average values. The decisions are made according to the difference of this value and one target without taking into account the process variation. The process control charts were developed in a previous project.

The setting up of the specification limits based on the real customer needs will allow the company to use a SPC control loop in the "Six Sigma way".

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Questionnaire design

Integrated approaches are normally time-consuming to answer and analyze, see for example, Yang, (2003); Tan and Pawitra, (2001). The most important constraint was that the questionnaire must take maximum 5 minutes to answer. It has three parts:

i- *Kano modified* questions for obtaining the satisfaction-performance lines, i.e. to link the subjective quality with the objective quality.

ii- *SERVQUAL modified*; the purpose is to measure internal and external customers' perceived performance and minimum service level.

iii- *Trade-Off Importance model* was designed to extract the customer relative importance of the different attributes.

Sample and data collection

We selected 9 internal stakeholders, the process owners of the different Key Performance Indicators (KPIs) and 9 external customers represented by people from finance and engineering at different companies and countries.
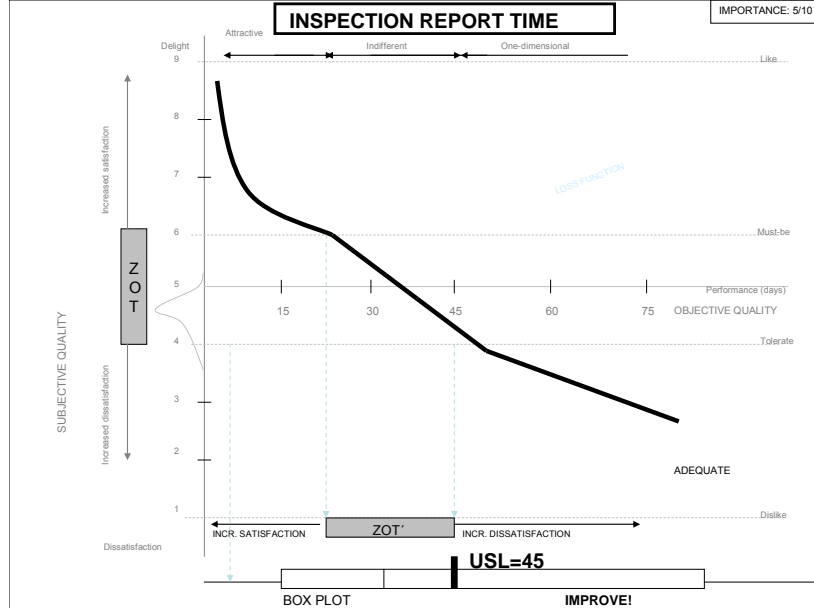
It is very important to have a high return rate. For example, (Yang, 2003), made a survey with an integrated approach, 1400 persons where mailed randomly, resulting in 150 valid questionnaires. In this situation the analysis of the questionnaires is useless because it does not represent the general opinion. Maybe, only the customers that are very satisfied or dissatisfied have answered.

Analysis

The model was applied for the six main KPIs in the service division; we will illustrate the analysis with an example (because of company confidentiality the real data have been somewhat manipulated). Inspection report delivery time is the time between the site job ends until the customer receives the inspection report.

In figure 8, the vertical axis represents the subjective side of quality, the customer perceptions of this attribute. The zone of tolerance is drawn between the "must be" and "I can tolerate it" line, in this zone the customers will not feel the variations. In the satisfaction area, the expectations are met, performance higher than the satisfaction area will lead to customer delight and lower to the ZOT will lead to dissatisfaction.

The horizontal axis represents the objective side of quality, the attribute actual performance represented in a box-plot gathered from historical data. The satisfaction-performance lines are drawn with a systematic roadmap based on the questionnaire answers of the customers. The satisfaction-performance line represents the customer satisfaction in function of the inspection report delivery time (in days). With the satisfaction-performance lines we can translate the subjective zone of tolerance to the objective ZOT.

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Figure 8.
Final graphic

In the graphic above there are three different areas:

Satisfaction area: Inspection reports between 20 and 45 days are in the indifferent area, the expectations are met the variations within this zone would have marginal effect in the customers' perceptions of the service.

Delight area: Inspections in less than 20 days is a delighter. This differentiates from the competitors.

Dissatisfaction area: Inspections in more than 45 days lead to external customer dissatisfaction; it is a bad performance in the process.
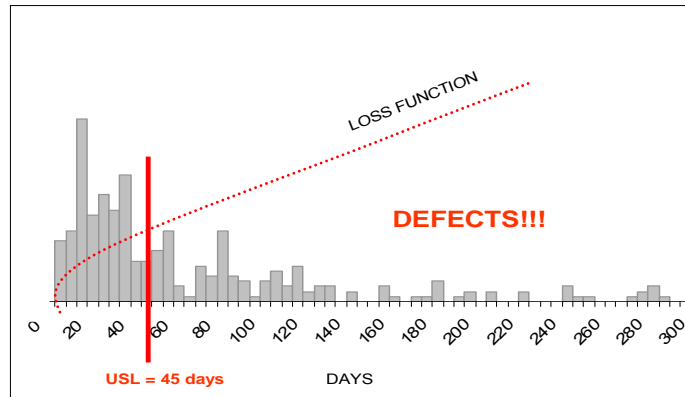
According to Bergman and Klefsjö, (2003), the quality of a product or service is its ability to satisfy, or preferably exceed, the needs and expectations of the customers. As long as the satisfaction-performance line is within the satisfaction and delight area, the organization is offering a high quality service. With more than 45 days of inspection report delivery time the customers start to be dissatisfied, The specification limit is marked in 45 days.

Capability analysis and target value

With the specification limits set by the customers, the real number of defects in the process can be calculated. To perform the capability analysis we assume that the distribution is normal. In services, where the human is the main player it is difficult to have normal distributions with 95% confidence level, it is needed to transform the data. Instead, we propose to calculate the percentage of conformance with specifications. There are tables to transform the yield into a sigma value.

Defining the quality loss as the customer dissatisfaction, by inverting the satisfaction-performance lines, the associated qualitative loss function can be drawn in the histogram. The loss function is very useful to understand that it is not just important to meet the specification limits. It is also important to center the distribution in the right area to maximize the customer satisfaction and minimize the associated cost.

This way of thinking was first introduced by Genichi Taguchi in the 1950s and early 1960s. Taguchi methods are claimed to have provided as much as 80 per cent of Japanese quality gains (Lofthouse, 1999).

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Figure 9.
Capability analysis

Improvement directions

The Importance Performance Analysis is a very simple, visual and useful tool. The vertical axis represents the attribute importance obtained from the "trade off importance model" and the horizontal axis the attribute perceived performance from SERVQUAL.

To enhance customer satisfaction, improvement efforts must be targeted in the attribute A. Improving attribute C will have a marginal effect in the customer service perception.
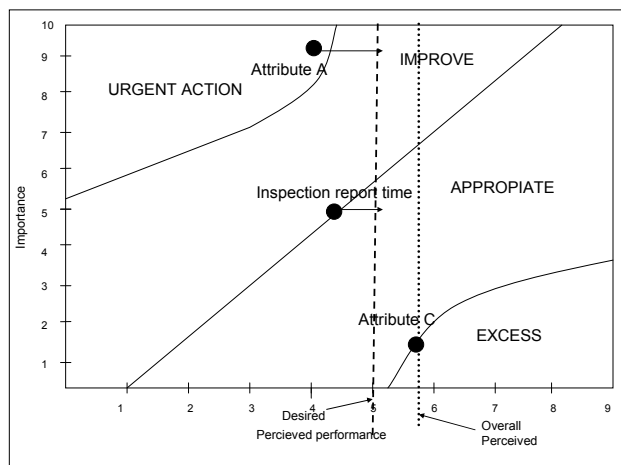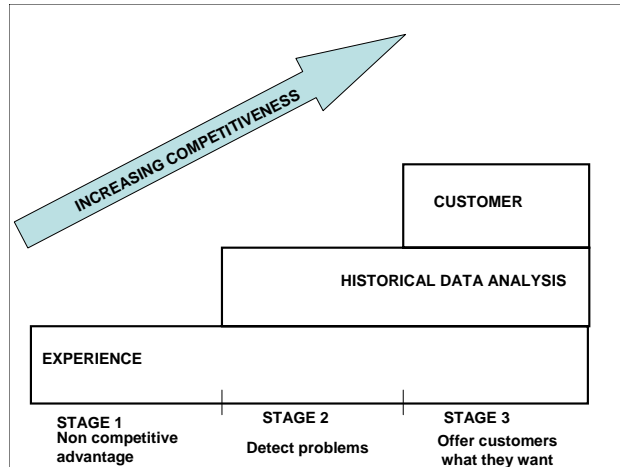

Figure 10.
IPA analysis

Practical implications

Every service organization uses the experience and Know-How for service excellence. However this does not give any real competitive advantage. Other organizations besides this experience they monitor the historical data to detect problems in the processes. The next step for the organizations is to listen to the customers, to link the experience with the historical data and with the customer expectations.

The Service Division, SIT AB, uses the experience, Know-How and the historical data in Six Sigma projects with very good results. It is currently between STAGE 1 and STAGE 2 of the proposed model (see figure 11).

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Figure 11. Proposed 3-Stage model for service excellence

But why does the organization hide the historical data in excel sheets with a lot of non relevant information. Why is only KPIs monitored? The historical data, well presented and interpreted can give extremely valuable information. The application of SPC would bring the company to STAGE 2, i.e. to detect problems in the process.

In this paper we have introduced a new way to communicate to customers. To know what they want, how they want it, what is really important for them and which are their perceptions about the service. The presented model links the three dimensions, experience, historical data and customer expectations and will allow the organization to go to STAGE 3 and offer the customers what they want.

Conclusions and recommendations

Today, firms compete with services rather than goods. Large service organizations are beginning to use Six Sigma as continuous improvement tool. An important part of the Six Sigma methodology is the calculation of number of defects in the process, i.e. points outside the specification limits. Unlike goods quality, which can be measured objectively by number of defects, in service goods the setting up of specification limits is a complicated issue because it is marked by the use and expectations among the different customers. As Six Sigma was originally created for manufacturing, this crucial fact is not contemplated in the Six-Sigma roadmap Define- Measure-Analyze-Improve-Control (DMAIC).

In this paper we presented a model to solve this issue and set the specification limits according to the customer expectations in services organizations. A review of relevant literature has been used to develop a new integrated model with ideas from Kano model, SERVQUAL, Taguchi loss function, Importance Performance Analysis (IPA) and a new model, the Trade-Off importance. A survey was carried out for 18 external and internal customers of the service division of Siemens Industrial Turbomachinery AB.

The output of the model is a chart that analyzes the most important KPIs in the Service Division from a general and objective perspective. The visual representation in the model of the Voice Of the Customer, the Voice Of the Data (VOD) and the Voice Of the Experience (VOE) creates value out of the data in one single graphic that cannot be attained

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through the use of either method alone. It makes this model a credible, robust and very powerful tool not just to set the specification limits but also, to set strategic directions, for a comprehensive service quality measurement and to improve the target setting in the Six Sigma projects.

The line that separates black (defect) and white (non-defect) in service processes is diffuse because is market by the customers. This paper is a contribution of a better understanding of what the customers think that is white, what the customers think that is black and which is the approximate line that separates black and white.
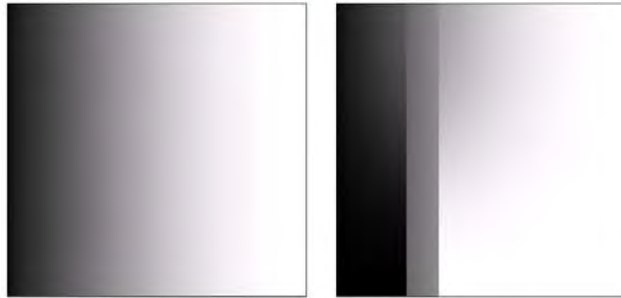
Figure 12

Managerial implications

This study is of interest for Siemens Industrial Turbomachinery AB managers. It will close the control loop and will allow the change of the traditional KPI bar charts for an SPC continuous health check. The real process sigma of the process can be calculated and the organization will use Six Sigma in its full potential.

The benefits in the SIT AB Service Division of the present study have a number of practical applications for service managers, mainly in organizations using Six Sigma or SPC policies.

Limitations and avenues for further research

This research has two main limitations, first, this is the first attempt to create a model to transform customer expectations into specification limits, there are a few articles published about this issue. We used for the first time the trade-off importance model and the Kano line drawing with more than 2 points. The proposed model must be further validated in future research.

Second, this study is applied in a single service division, with a relatively small sample. Ideal research should be conducted using multiple industries in order to ensure that the model is generalizable.

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Prioritizing the main influencer factors of service quality by using the hysteresis model; a case study on retail banking

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Abstract

Purpose --- previous researches in service quality and customer satisfaction in retail banking because of their partial viewpoint have only partial applications. Fact is that, managers in the process of decision making need comprehensive information about customers. Decisions made with partial information have a little reliability. This study attempts to debate about service quality and customer satisfaction in comprehensive way.

Design/methodology/approach --- the sample of the study consists of Iran's Melli bank customers located in Tehran, the capital of Iran. The questionnaire was based on hysteresis model's variables (Attractiveness, zone of tolerance) and effect. Psychometric properties of the scale (such as reliability) were tested.

Findings --- the hysteresis model presented here and the results of the study reveal the integrity of staff, security of account information and accuracy in operations as the most important factors in retail banking.

Research limitations/implications --- first the sample of the study is small and is limited to the Melli bank customers. Second, the number of factors which were investigated are low.

Originality/value --- it has not been conducted any empirical research using hysteresis model to see whether it replicates previous researches. This study is necessary, useful and relevant because; it focuses on the service quality and the study explores service quality in a comprehensive way (hysteresis model).

Keywords --- service quality, Kano model, hysteresis model, banking
Paper type: research paper

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Introduction

Service sector in most countries as a dominant sector has replaced others. With the increase in the share of services came increased consumer concerns over the perceived deterioration of service quality (Mersha and Adlakha, 1992). Because of a positive relationship between service quality and customer satisfaction it has become the subject of many researches. Some provide modeling and measurement scales for customer behavior. For instance, SERVQUAL from Parasuraman *et al*. (1985) in the field of service quality determinants, Kano *et al*.'s (1984) model and Johnston's (1995b) work in determining the effects of the service quality factors, Liljander and Standvik's (1993) and Johnston's (1995a) work in the field of disconfirmation theory and zone of tolerance and finally Johnston's (1997) work in identifying the critical determinants of service quality.

It has often been said that simpler an idea, more powerful it is. Previous researches in consumer behavior and service quality (that some of them mentioned above) because of their partial viewpoint have little applications and some times are contradictory, so have a little reliability. Hysteresis model in consumer behavior is a simple and broader model that clears the Complexity and contradictory of previous models.

Banks are one of the most important financial institutions in all countries. Bank managers in order to increase the profitability of their organization, have focused on productivity so, today they act as bureaucratic service organizations. Some principles of these organizations aren't compatible with human inner. On the other hand, the basic differentiator in today's market is service quality. In general, service quality promotes customer satisfaction and stimulates intention to return. In this paper some characteristics of retail banking service have been selected for investigation and the hysteresis model with it's more variables can give reliable and valid results. First we discuss about service quality determinants, effect and zone of tolerance, then hysteresis model as a broader model and its relationship with previous models comes in the next. The research methodology is explained and finally conclusions end up the discussion.

The determinants of service quality

There is a no universally accepted definition of service quality and most writers in this area support customer centered definition. In other word, quality like a beauty is in the eyes of the beholder (Peters, 1999).

Underpinning our understanding of service quality is an array of factors or determinants. A number of researchers have provided lists of quality determinants (see for example: Parasuraman *et al*. (1985) and (1988); Johnston *et al*. (1990); Bahia and Nantel (2000); and etc.)

Parasuraman *et al*. (1985) provided a list of ten determinants of service quality; access, communication, competence, courtesy, credibility, responsiveness, security, understanding, and tangibles. Later, they developed an instrument called SERVQUAL for measuring customer perceptions of service quality. In the process of developing SERVQUAL, Parasuraman et al. (1988) condensed the ten dimensions of service quality listed above in to five: tangibles, reliability, responsiveness, assurance and empathy (see table I). They reported that, regardless of the service industry, reliability is the most important factor to service quality and tangibles is the least important.

SERVQUAL has been the source of some criticisms. Later, Johnston *et al.* (1990) undertook some testing of the SERVQUAL comprehensiveness. After, further testing and development they provided 18 determinants of service quality; access, aesthetics,

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attentiveness/helpfulness, availability, care, cleanliness/tidiness, comfort, commitment, communication, competence, courtesy, flexibility, friendliness, functionality, integrity, reliability, responsiveness and security.

Table I: SERVQUAL Dimensions

SERVQUAL Dimensions	Components
Tangibles	Tangibles
Reliability	Reliability
Responsiveness	Responsiveness
Assurance	Competence Courtesy Credibility Security
Empathy	Access Communication Understanding

Effect

Previous researches in services acknowledge a strong positive correlation between service quality and satisfaction. However, the directionality of the relationship has been the source of much debate. Some models identify factors which will influence consumer behavior in only one direction (for example, satisfiers and dissatisfiers (Johnston, 1995b) and attractive and must be quality (Kano *et al.* (1984)) while others tend to assume that the effect of changes in a variable will be reversible, influencing consumer behavior in both directions. There have been some researches, which have sought to identify some of the determinants of satisfaction or dissatisfaction. First Kano *et al.* in the paper of "Attractive quality and must-be quality" have identified three major types of factors (see figure 1).

1-Basic factors. (Dissatisfiers or Must have) - The minimum requirements which will cause dissatisfaction if they are not fulfilled, but do not cause customer satisfaction if they are fulfilled (or are exceeded). The customer regards these as prerequisites and takes these for granted. Basic factors establish a market entry 'threshold'.

2-Excitement Factors. (Satisfiers or Attractive) - The factors that increase customer satisfaction if delivered but do not cause dissatisfaction if they are not delivered. These factors surprise the customer and generate 'delight'. Using these factors, a company can really distinguish itself from its competitors in a positive way.

3-Performance Factors. The factors that cause satisfaction if the performance is high and they cause dissatisfaction if the performance is low. Here, the attribute performance-overall satisfaction is linear and symmetric. Typically these factors are directly connected to customers' explicit needs and desires and a company should try to be competitive here.
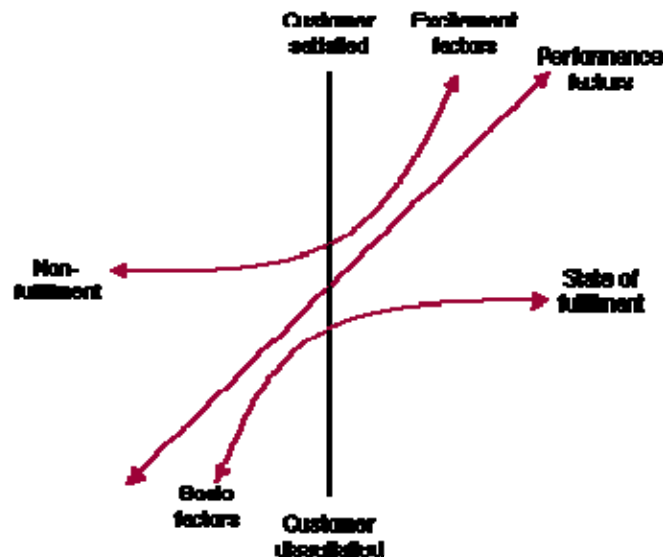
Figure 1: Kano model

Also, Silvestro and Johnston (1990), with inspiration of Herzberg`s (1959) motivating and hygiene factors, identified hygiene (dissatisfiers), enhancing (satisfiers) and dual (both satisfier and dissatisfier) factors.

Bahattacharya and Rahman (2004) conducted a comprehensive test using Kano model in retail banking this research blocks the service quality factors in three main categories (Basic factors, performance factors, Excitement Factors).
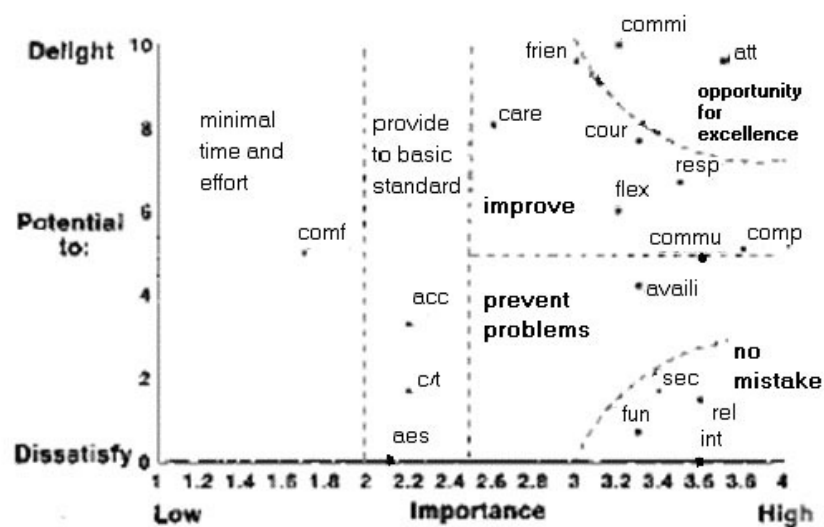
Also, Johnston (1995b) provides a comprehensive overview of the literature. He concluded that there might be a distinction between satisfiers and dissatisfiers. He goes on to describe a major study of satisfiers and dissatisfiers in retail banking. There were only four exclusive determinants of satisfaction or dissatisfaction with the bank:

(1) Integrity (dissatisfier);

(2) Commitment (satisfier);

(3) Aesthetics (dissatisfier); and

(4) Cleanliness (satisfier).

The sources of satisfaction (attentiveness, responsiveness, care and friendliness) Concerned with the intangible nature of the service and dissatisfiers have both tangible and intangible aspects. Later, Johnston (1997) to improve his previous work imported the importance variable in his investigation (see figure 2). Johnston noted that: "The problem with this work, and with assessing effect without considering importance, may be a distortion of priorities". Also, Johnston believes that the dissatisfiers are more important than others.

"It is more important to ensure that these dissatisfiers are dealt with before the satisfiers. Having a polite and courteous staff is a little consolation for a customer who feels highly dissatisfied because of an integrity- or security-type error, for example".

Johnston's 1997 work is the best research in this area. This research considers the effect of service quality factors as one of the most important variables in prioritizing. It benefits from Johnston's view ("it is more important to insure dissatisfiers …") in the process of prioritizing.
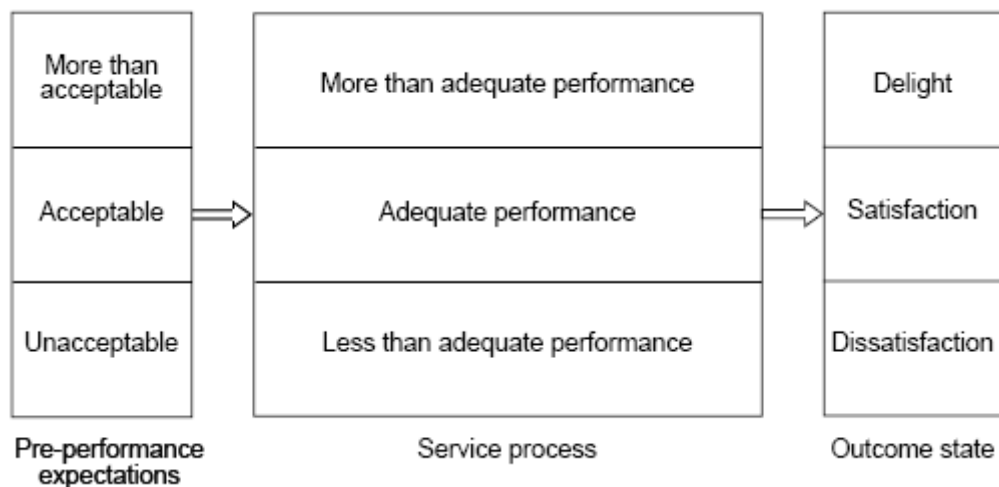
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Figure 2: Priorities to improve

Zone of tolerance

One of the most important debates was emerged in service quality concerns the definition and use of zone of tolerance. The zone of tolerance model is based on the view that service quality results from customer's comparing their expectations prior to receiving service to their perceptions of the service experience it-self. If a customer's perceptions were matched by his/her expectations, then the customer is satisfied with the service, if the experience was better than expected, then perceived service quality high and the customer is delighted. If the experience did not meet expectations then service quality is perceived to be poor and the customer is dissatisfied (see for example, Parasuraman *et al.*(1985)).

Poiesz and Bloomer (1991) proposed that the zone of tolerance can be use as the unifying construct between expectations, performance and outcome. Johnston, (1995a) defines three interlinked applications of the zone of tolerance; a description of an outcome state, a description of a range of pre-performance expectations and the satisfactory range of in-process service performance (figure 3 Shows the zone of tolerance applications graphically).

Figure 3: applications of zone of tolerance; adopted from Johnston (1995a)

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An interesting new development in the service quality discussion is to consider expectations and evaluations as zones not a discrete point on a scale. They argue that customers might not be capable of giving points on estimates. The most accepted model of the zone of tolerance is an overall measure of the difference between an adequate service and desired service proposed by Zeithamle *et al.* (1993)

Johnston (1995a) proposes that the performance within the zone of tolerance may not be noticed. In other word, sensitivity of perceived service quality to variation in the service is depending upon the zone of tolerance.

Hysteresis model

Galloway (1999) with inspiration of hysteresis Phenomenon in Physical sciences developed the hysteresis model with the aim to reduce the complexity and contradictory of previous researches in service quality literature. As he says, "…at least some of this complexity is an artifact of partial viewpoints". As Galloway says, mathematical details and practical applications of this phenomenon are not needed.

As Galloway`s article, the hysteresis model has three characteristics which it is apply to consumer behavior:
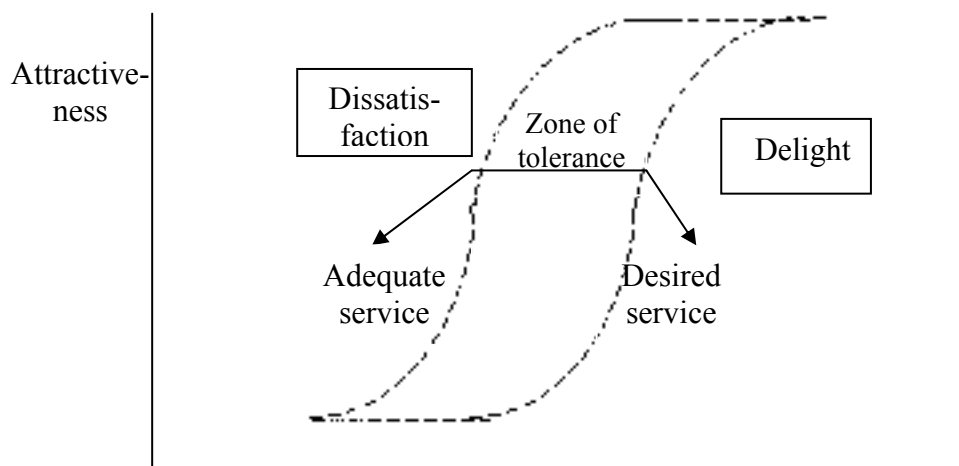
- **First**, there is a non-linear relationship between an applied variable and a response variable. Kano's model, as seen, assumes that there is a linear relationship in performance factors but the other two factors assume non-linear relationship. Also, this is in common with microeconomic utility concepts, which it assumes increasingly or decreasingly increasing relationship between consumption and total utility.
- **Second**, the response variable becomes saturated. As performance increase, the attractiveness receives to a point that more performance beyond on it has no effect on attractiveness. This is in common with microeconomic utility debates too; and
- **Third**, the relationship between the two variables is predictable and consistent, but nonreversible. In contrast with the previous models, the most dominant advantage of the hysteresis model is in this characteristic. The next section describes the relationship between the hysteresis model and the zone of tolerance.

Hysteresis model and the zone of tolerance

The zone of tolerance embodies the concept of non-reversibility implicit in hysteresis (Galloway, 1999). Zeithaml *et al*. (1993), define the zone of tolerance between the expectations of customers. It is distance between adequate and desired service in customer expectations from a service.

Galloway (1999) determines the zone of tolerance within the extremes of the hysteresis envelope. As mentioned above, sensitivity of perceived service quality to variation in the service is depending upon the zone of tolerance (see figure 4 for example).

"If the performance of a service lies within the extremes of the hysteresis envelope, then there will be no change in the state of the customer - the outcome will be satisfactory. If the performance falls outside the envelope on the negative side, dissatisfaction will result, while a performance on the positive side will result in delight" (Galloway, 1999).

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Figure 4: hysteresis model and the zone of tolerance

The most important issue related to this research is in how the zone of tolerance concept is used. Professor Galloway clearly relies on factors with a little zone of tolerance. As can be understand from the zone of tolerance or hysteresis models, it is more likely that variation in performance on factors with a little zone of tolerance could result on significant degree of customer satisfaction/dissatisfaction.

Research questions

This study seeks to priorities the main service quality factors in retail banking based on the hysteresis model's variables (attractiveness, zone of tolerance) and effect. Its purpose is to measure, through empirical research in Iran's banking industry, effect, attractiveness and zone of tolerance of service quality factors, so managers might be better armed to decide how to allocate limited resources to improve or stabilize service quality. This is summarized in terms of three research questions:
1) Which quality factors are the ones which tend to delight customers and which are those that tend to dissatisfy?
2) In which quality factors customers have limited zone of tolerance?
3) In which quality factors, performance of the bank provides little attractiveness to customers?
4) And finally, do empirical evidences confirm comprehensiveness of hysteresis model? (do results replicate previous researches?)

Professor Galloway does not provide any scale or method to measure his model's variables since we designed a simple self-reported measurement scale. It is important to note that performance only aspect used to measure the zone of tolerance rather than gap analysis.

Research method

One major Iranian bank agreed to be involved and to provide direct access to its customers from several branches. Some major quality factors were determined to investigation and a close-ended questionnaire was used to measure; the effect of each quality factors, the Attractiveness of each factor to customers and the amount of tolerance of customers in these factors. The questionnaire was designed in 4 sections. Section one was about the customers' demographic information (sex, education, account type and account amount). Section two measures customer satisfaction in each quality factors (attractiveness of each quality factors for customers) using five

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point Likert scale from "very satisfied" to "very dissatisfied". Section three determines the effect of each quality factors. The question of "what's your viewpoint about each of these factors?" was asked. The answers of "it is indifferent" (neural factors indicator), "it is better" (dual factors indicator), "it is excellent" (pure satisfiers indicator), and "it should be" (pure dissatisfiers indicator), were provided as available alternatives for the customers who answer. Moreover, C-S coefficient was calculated for each quality factors using these formulas:

$$\text{Satisfaction coefficient} = \frac{\text{Frequency of answers to "it is excellent"}}{\text{Total answers}}$$

$$\text{Dissatisfaction coefficient} = \frac{\text{Frequency of answers to "it should be"}}{\text{Total answers}}$$

And finally, section four measures the tolerance of customers in each of factors if deterioration occur. The question of "how much you tolerate if deterioration from your desire in each quality factors occur?" was asked. The answer alternatives were scaled from "much more" to "very little". The last three sections, to unifying the effect of variables in the prioritizing process, were ranked from 1 to 9 (1 shows the least important alternative and 9 as the most important one)

In this research ten variables of service quality were selected for investigation. The variables of this research and their dimensionality have been shown in table II (except to e-banking that we excluded it in dimension based analysis because of its multi-dimensionality). Psychometric properties of the scale (such as reliability) were tested. 250 questionnaires were distributed and 199 of them were found to be useful. The final Choronbach's alpha for the whole questionnaire was .83 (the Choronbach's alpha for each section has been provided in table III).

Data analysis
Descriptive statistics were calculated using SPSS 14. Briefly, calculated scores for each of these factors and variables have been provided in table IV. As it shows, Staffs truthfulness, security of account information, and accuracy in operations are the most important factors and staff neatness and beauty of the branch are the least important ones.

Table II: Service quality factors

Reliability/Assurance	Staffs truthfulness (tru)
	Security of account information (sec)
	Accuracy in operations (accu)
Empathy/Responsiveness	Staffs attempt in their work (comm)
	Staffs listen to your questions carefully (att)
	Speed of operations (fast)
	Staffs friendly relation (friend)
Tangibles	Staffs are neat (neat)
	Overall beauty of branch (beauty)

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Table III: Choronbach's alpha

Research (hysteresis) dimensions	Choronbach's alpha
Attractiveness	.887
Zone of tolerance	.918
Effect	.884

Table IV: Priorities to improve

factors	Attractiveness scores	Zone of tolerance scores	Effect scores	Total
Staffs truthfulness	7.681	4.861	7.211	19.753
Account information are secure	7.3	5.124	7.034	19.458
Accuracy in operations	7.648	4.78	6.669	19.097
Staffs attempt in their work	7.474	4.328	6.535	18.337
Staffs listen to your question carefully	7.073	4.615	6.358	18.046
Speed in operations	6.743	4.719	6.467	17.929
E-banking	6.453	4.542	6.63	17.625
Staffs friendly Relation	6.997	4.174	5.026	16.177
Staffs are neat	6.625	4.276	5.179	16.08
Overall beauty of branch	5.926	4.3	5.191	15.417

Multiple comparisons were conducted to show whether differences between the items are significant. Test distribution for all of factors was normal and Levens test for homogeneity of variances was controlled. The results of ANOVA table show that from the tolerance view, there is a no difference between the dimensions either between the elements in dimensions (see tables V and VI). But from the Attractiveness view we can see some differences between the items in dimensions. In the empathy/responsiveness dimension we can see difference between the commitment and speed in operations elements. The reliability/assurance and tangibles dimensions had variance problem and any transform process was not resulted to homogeneity of variances since we conducted nonparametric test, inevitably. The result of Kruskal-Wallis test for reliability/assurance dimension shows no difference

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between elements but it shows differences between the three dimensions(see table VII). Also Mann-Whitney U shows significant difference between staff's neatness and beauty of branch elements (see table VIII).

Table V: ANOVA Dimension based analysis of Zone of Tolerance

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	144.563	2	72.282	.814	.443
Within Groups	158679.827	1788	88.747		
Total	158824.390	1790			

Table VI: ANOVA factor analysis for tolerance in elements within dimensions

| Dependent variable (Tolerance of customers)	Sum of squares	df	Mean Square	F	Sig.
Reliability/Assurance					
Between Groups	3.193	2	1.597	.763	.467
Within Groups	1227.831	587	2.092		
Total	1231.024	589			
Empathy/Responsiveness					
Between Groups	9.410	3	3.137	2.125	.096
Within Groups	1158.547	785	1.476		
Total	1167.957	788			
Tangibles					
Between Groups	.009	1	.009	.007	.933
Within Groups	520.659	393	1.325		
Total	520.668	394			

Table VII: Kruskal-Wallis test for Attractiveness between the reliability/assurance elements and service dimensions

	Reliability/Assurance	Service dimensions
Chi-Square	5.547	86.342
df	2	2
Asymp. Sig.	.062	.000

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Table VIII:

	Tangibles
Mann-Whitney U	16604.000
Wilcoxon W	36305.000
Z	-2.813
Asymp. Sig. (2-tailed)	.005

Moreover χ^2 test in the section 3 of questionnaire, which measures the effect, shows that the frequencies of the response alternatives were significantly different from the expected frequencies. With a hysteresis scores (sum of the attractiveness and the zone of tolerance scores) in horizontal curve and effect (C-S coefficients) on vertical, we can show priorities graphically as figure 5. Comparing with Johnston (1997), high correlation is seen between the two studies especially, from the importance view.
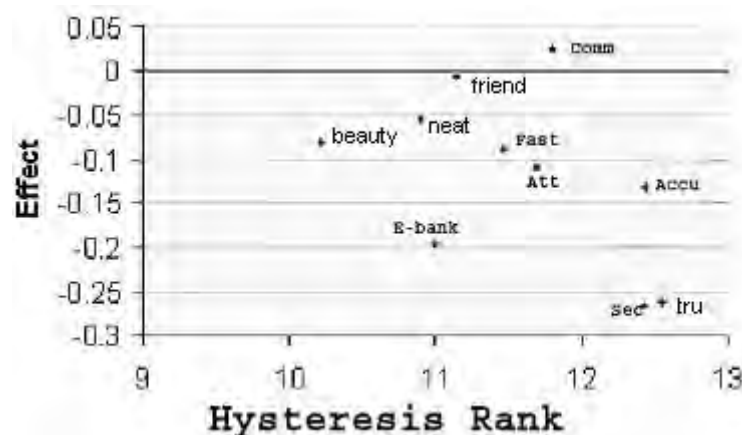
Figure 5: priorities to improve

Conclusion and managerial implications
This research will provide managers with a framework to help them assess the likely impact of service quality factors in terms of its effect, attractiveness, and zone of tolerance.
All variables of this research were in customers' expectations and no one was beyond the expectations.
Staffs' truthfulness, security of account information, and accuracy in operations, have been shown to be the most important factors to customers which supports previous work by Johnston (1997).
Since factors with a little zone of tolerance are the most sensitive and factors with a high zone of tolerance are the least ones so the most sensitive element was security of account information and the least sensitive ones were staffs friendly relation and staffs neatness.

From the effect view, based on the management interests both reliability/assurance and empathy/responsiveness dimensions can be used. If the management interest and or organization problem is customer dissatisfaction since focusing on reliability/assurance dimension can give better results but if the management interest is satisfying customer as much possible empathy/responsiveness dimension elements can give better results. The research has also shown that some areas which have not worth of much attention are tangibles. Any time and money would be better redirected elsewhere.

And finally, the replicability of the results of this research with peer reviews reveals this fact that empirically, the hysteresis mode is a simple reliable and valid model in marketing literature to measure service quality from the customers' view.

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WAGE ADMINISTRATION
IN TOTAL QUALITY MANAGEMENT

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Abstract

Purpose – This study aims to examine the wage administration system that could be able to motivate the employees to pursue quality. The goal of the research is to design this kind of wage administration system.

Design /methodology/ approach – The paper is based on the research results used worldwide for wage and salary administration systems and on their adaptation to the TQM methodology, also on the experiences of implementation of wage and salary administration systems as a personnel motivating method to achieve quality in Lithuanian companies.

Findings - The necessity of special wage administration system in total quality management was proved. The expedience of joint method for assessing all carried work in an organization was reasoned. The expedience of unified wage administration system in total quality management was reasoned. The unified wage administration system that motivates employees to pursue quality was prepared.

Originality/value – This study contributes to examine the wage administration system from the perspective of motivation employees to pursue quality. The findings of this study are useful in providing managerial implications for company administrators to make the wage administration system as a method of motivation to pursue quality.

Keywords: TQM, wage administration, motivation, job evaluation.

Paper type: Conceptual paper.

Introduction

The paper deals with the scientific and practice dilemma: what should be wage administration system that could be able to motivate the employees to pursue quality? The goal of the research is to design this kind of compensation system.

The following goals were achieved:

- The necessity of special wage administration system in total quality management was proved.
- The expedience of joint method for assessing all carried work in an organization was reasoned.
- The expedience of unified wage administration system in total quality management was reasoned.
- The unified wage administration system that motivates employees to pursue quality was prepared.

The necessity of attempt to use wage administration as employees' motivation

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The main business goals are to satisfy its customers and to do that better than the competitors, to build customer loyalty and to capture the market. The key aim of wage administration is to assist the organization in the implementation of its strategic goals and short-term objectives when developing qualified, competent, dutiful and motivated employees.

Specific goals in creation of the compensation system:
- To help to join organizational values, achievements, standards and expectations.
- To assist the implementation of organization's culture, processes and structure development programmers.
- To assist the implementation of organizational foremost values: quality, customer satisfaction, teamwork, innovations, professional versatility, and proactiveness.
- To stimulate the employees to pursue organization's goals.
- There is a need to answer the question when designing the compensation system:

"What behavior do we expect from employees?"

"How the wage administration system will shape expected behavior?"

Effective wage administration strategy:
- is based on shared values and aspirations;
- is determined by business strategy and alongside helps to prepare it;
- is designed according to the business needs;
- takes into account the competence;
- coincides with the organization's internal and external environment;
- rewards for good results and behavior, which is aligned with organization' key goals;
- is related to business strive for assurance of competitive future;
- is practical and easily implemented.

Accordingly, the effective wage administration strategy in TQM must be based on employees' motivation to pursue quality. If we increase the wage and this increase will not be related to employees' behavior formation, the system will not be effective and the employees will not start to work better. Therefore, it is necessary to organize wage administration system in the way that it would become a motivating factor and help to implement TQM methodology in an organization, which, as we know, is a backbone of competitiveness.

Usually the question arises if there is a need to stimulate the pursue of wage administration based on work quality. This is not a simple question. For a long time the issue about wage administration was absent in academic papers (Carr, Hard and Trahant, 1996, Maira and Scott-Morgan, 1996, Ruzevicius,, Adomaitiene and Sirvidaite, 2004). It was commonly assumed that the employee gets the pay only for a qualitatively performed work. And what is more there are widespread wage systems - piece progressive and time progressive. In the latter case, the wage consists of the two parts: fixed and variable. It does not matter if time or piece wage form is used; firstly, a fixed part of wage per hour, per piece or per month is calculated. The size of constant part of wage is fixed depending on the job content, which requires special skills and on its complexity. For defining variable or "progressive" wage part, usually certain percentage from fixed part of the wage is given; let us say it is 50 %. Next, the faults are taken into account and every fault reduces the percentage by several points. If the employee is a complicated personality, he does not get the variable part of wage. Is it a good wage administration system? What kind of employees is it orientated towards? Usually we do not have more then 3, 4 or 10 % of undisciplined employees. Is it worth wile to organize such kind of system specially suited for this kind of employees? Can this system improve employee discipline? There is only one answer – no. Therefore, it is not worth to have such compensation system that does not motivate employees to perform their work well and produce quality. Moreover, what about the rest 90 % of employees? They are not motivated at all by this system. Therefore, it is necessary to organize wage administration system in the

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way that the employees will be motivated to improve their department's and all organization's performance in order to meet the needs and expectations of their internal and external customers.

The choice of wage form in TQM

In many countries, companies use two forms of wage: timework payment and payment per piece. Using payment per piece system, the wage depends on quantity of jobs and tariff per piece, which depends on job content and conditions. Using timework payment system, the wage depends on time consumed for work and on tariff per time unit, which depends on job content and conditions. Naturally, the question is which wage form is better suited for TQM.

Payment per piece stimulates employees to perform as much work as they can per shift or other time period. Therefore, even very diligent and honest employees pay more attention to the quantity then to the quality of their work. It is necessary to do not as much work as you can but to do only the work which is essential to meet customer requirements, i.e. the employee must fulfill only his contractual liabilities. Too many products manufactured at different workplaces are not useful but even destructive as the products must be additionally stored in warehouses. Consequently, we get freeze of working capital and the company needs more of it to maintain operations. For effective management of working capital just-in time system was designed.

Having timework payment system, the employees are not interested to do as much as they can. Therefore, main efforts could be devoted to pursue work quality. However, there are business people that avoid timework payment system because the employees then are not apt to do as much work as they can. This could happen if we do not complement timework payment system with the obligatory task. It is very important for tasks to be optimal and possible to perform with reasonable work intensity. Accordingly, establishment of optimal workload in TQM is a very important scientific and practice issue.

There is one more physical and mental payment problem as we still cannot resist dividing work into physical and mental one and accordingly the employees into blue-collar and white-collar ones. But in TQM the wages system must motivate all the employees to continuously improve their work, to aspire after best quality. Continuous improvement of an organization is an integral process. There are no insignificant jobs in a well-organized system. Therefore, all the employees are equally important even if their work content and positions are different. Consequently, there is no theoretical or practical reason to have different wage system for physical and mental work. It is purposeful to have homogeneous timework payment system with the fixed task obligatory to perform. Homogeneous wage system can assure social justice. All the employees especially blue-collar workers will feel that they are valued the same as white-collar workers or managers. It will improve their satisfaction with the work and emotional environment as well as solution of quality issues.

Peculiarities of work assessment in TQM

Usually different methods are employed to assess physical and mental work. But for implementation of homogeneous wage system in TQM it is necessary to implement uniform methods for this purpose.

It is very important to separate two wage constituents in TQM. Fixed part of wage should depend on work place, its content. Variable part should depend on the employee's behavior at work. However analytical (quantitative) methods employed to evaluate job usually assess not only the content of the workplace but employee's behavior features (eg: proactiveness and resourcefulness) as well.

The experience of the author when implementing TQM and work forms stimulating total quality in Lithuanian companies evidence that it is possible to use general methodology for

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assessment of all work carried at a company. Analytical work assessment by points would suit best in this case (Milkovich and Newman, 1996). Work content depends on technology employed, structure of manufacture and management, and other circumstances. Therefore, different factors could be involved in different companies. But for all jobs carried at a company it would be purposeful to use such factor as work complexity as it depends on employee qualification, demand of physical energy, strain of vision, level of responsibility. In some companies (e.g. banks) retention of confidential information is a very important factor. The same factor can exist in manufacturing companies as well, when it is necessary to keep commercial and technology secrets (Vanagas, 1994, 1996, 1997).

In some countries, we can find work conditions as a factor in work assessment system but in some countries, there is no need to take into account this factor. For example in Lithuania the payment for work under harmful, unhealthy conditions, for night work and overtime is regulated by labor payment law. Therefore, these factors in work assessment techniques are not taken into account.

Now general analytic work assessment method using points would be discussed. It is purposeful to form expert group for organizing work assessment and payment. The group should prepare the project of payment provisions including work assessment methodology.

Firstly, the factors that should be taken into account when designing work assessment methodology must be discussed.

Let's say that we decided to assess the jobs according to their complexity, responsibility level, need for physical energy to carry the work and level of vision strain. Then the essence and attributes of these factors should be find out and consequentially to decide how these factors will influence the wage (i.e. what percentage of timework payment should be allotted for work complexity, for responsibility, for need of physical energy and for strain of vision). There are no conventional proportions for this matter. Experts must decide this but usually work complexity should comprise the biggest part of payment because this factor involves the requirements not only for employee's qualification, length of service but also for his personal traits and practical skills, e.g. communicativeness, ability to take decisions independently, etc. Let's assume that work complexity comprises 45 %, physical energy – 15 %, vision strain – 15 %, and responsibility level – 25 % of pay per hour.

After work analysis according to above-mentioned factors, it is important to distinguish and define the level of every factor. Then the level must be scored.

In standard work assessment by points (scoring) methodology the difference between minimum and maximum scoring usually is five times (ratio 100 : 500). Maybe this difference is satisfactory when blue-collar and white-collar employees are assessed separately. But this difference is apparently small when there is one general work assessment methodology. The difference depends on wages policy at a company.

The biggest and the smallest payment ratio (motivation coefficient) depends on company's internal factors and external conditions.

The difference of the smallest and the best payment depends on the following internal factors:
- amount of employees;
- market strategy and tactics;
- amount of means of payment.

The more management and employee levels exist, the bigger motivation coefficient should be. If a company intends to undertake aggressive market strategy, widen the range of products it is necessary to increase motivation coefficient because the employees are not as sensitive to the absolute amount of their payment as to the difference of payment among their colleagues, among top managers and subordinates.

What intervals should be taken when calculating different factor level? The widely used

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arithmetic progression is not satisfactory especially evaluating levels of high-qualified work.

Let us analyze the evaluation of every factor separately. Hereinafter the examples are taken from authentic project carried out at a furniture manufacturing company, which employed 100 people.

Work complexity

What attributes show the content of the work and its complexity? There are many theories and methods to evaluate the content of work. They are very detailed and complicated, based on amount of information and other methods. Maybe they are very accurate but it is difficult to apply them for work assessment at a company. Therefore easier understandable attributes are used to define job content: time needed to learn to carry the job, method of training, need for length of service, complexity of decisions taken. Practice revealed that it is easier to define complexity levels of blue and white collar workers separately. It is also important to mention that the attributes of work complexity (time needed to learn the work, need for intelligence in taking decisions) could be assessed separately. The example of work complexity assessment is given below in Table I (Vanagas, 2007).

Level	Workers' job	Executives' job	Points
1	Simple routine jobs that require knowing few procedures. Jobs of this category can be learned at the workplace in one week. *(loaders, cleaners, new grinders)*		40
2	Simple repetitive tasks that require knowing of various procedures. Learning jobs of this category at the workplace may take up to three months. *(experienced grinders, operators of separate operations)*		80
3	equipment operators' and smiths' Jobs that are done with the surveillance of higher qualification specialists when adjustment, readjustment or repair of equipment is not carried out. Therefore, it is not necessary to know composition of equipment aggregates or kinematics. Accomplishment of this category jobs requires for specific education at the industrial school or at the organization up to 6 months. *(smiths, vaneerers, varnishers, packers, constructors repairers).*	"Standard" jobs that are clearly practice-defined and well known, jobs delegated by specialists and managers. Accomplishment of this category jobs requires for assessment of the situation, use of several procedures based on personal opinion and specific knowledge. Learning and accomplishment of this category of jobs requires for secondary education, studying specific courses or learning at the workplace that may take up to 3 months. *(store-woman)*	120
4	Independently performed jobs.	This position requires for knowledge in	160

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Level	Workers' job	Executives' job	Points
	Accomplishment of this category of jobs requires for specific education at technical (industrial) school or at the organization up to 6 months and also previous experience (seniority) of one year is necessary. *(electricians)*	the specific field obtained in vocational schools (colleges) in order to be able to select one of the familiar decisions. *(accountants, bookkeepers)*	
5	Independently performed the most difficult jobs of woodworkers that require learning in specific technical (industrial) schools and afterwards experience (seniority) of 3 years is necessary. *(woodworkers)*	This position requires for knowledge in the specific field obtained in vocational schools (colleges), wide range of work procedures and facts for analysis in order to be able to select one of the familiar decisions. *(secretary, cashier-bookkeeper, supplier-driver)*	220
6		This position requires for knowledge in the specific field obtained in vocational schools (colleges), wide range of work procedures and facts for analysis in order to be able to select one of the familiar decisions. Previous experience (seniority) of 2 years is necessary *(administrator)*	280
7		This position requires to know policy and procedures of the organization, to be able to manage departments of the organization or complex field of its activity. This position requires to strive for results by creating new products, techniques or adapting known cases for new conditions. Decisions are made based on personal experience and policy of the organization. Specific education is necessary. *(shift supervisors, manager)*	340
8		This position requires to know policy and procedures of the organization, to be able to manage departments of the organization or complex field of its activity. This position requires to strive for results by creating new products, techniques or adapting known cases for new conditions. Decisions are made based on personal experience and policy of the organization. Specific education is necessary as well as	420

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Level	Workers' job	Executives' job	Points
		experience of 2 years of previous practical work. *(manager, assistant of production coordinator, construction chief)*	
9		This position requires to know policy and procedures of the organization, to be able to manage departments of the organization or complex field of its activity. This position requires to strive for results by creating new products, techniques or adapting known cases for new conditions. Decisions are made based on personal experience and policy of the organization. Higher education is necessary as well as experience of 2 years of previous practical work. *(quality engineer)*	520
10		Preparation of projects and decision-making concerning new or ever-changing issues. Accomplishment of this category of jobs requires exceptional skills, assessment of mix of intricately evaluated factors or decision making under conditions of lacking information. Higher education is necessary as well as experience of 5 years of previous practical work. *(supply manager, chief constructor-technologist, chief accountant, chief financier, assistant manager for production)*	700

Table I. Complexity of work

Responsibility at the workplace

For many organizations it is very difficult to find managers for responsible positions, because the higher management level is the greater responsibility manager assumes. And it is not compensated for the latter.

It is purposeful to assess responsibility at the workplace in respect of four responsibility objects: responsibility for equipment and technology (Table II), responsibility for tangibles (Table III), work responsibility (Table IV), and responsibility for health and life protection (Table V).

Level	Description	Points
1	Responsible for equipment and tools used at the workplace	7
2	Responsible for equipment assigned for small groups of workers	35

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Level	Description	Points
3	Responsible for equipment and technology of the whole department	66
4	Responsible for facilities and/or technology of the whole organization	103
5	Responsible for progress of technology and the whole organization	140

Table II. Responsibility for equipment and technology

Table 3

Level	Description	Points
1	Responsible for tangibles at the workplace	7
2	Responsible for tangibles assigned for the group of workers	15
3	Responsible for the protection of organization's asset or accounting within their competence/authority	35
4	Jobs of persons with whom contracts of responsibility for tangibles are concluded	85
5	Responsible for all tangibles of organization	150

Table III. Responsibility for tangibles

Level	Description	Points
1	Responsible for his/her work only (all employees)	6
2	Responsible for work of lower qualification co-workers (subordinates)	20
3	Responsible for work of the shift of manufacture department (foreman, forewoman)	35
4	Responsible for work of the section of manufacture department (independent section managers)	60
5	Responsible for work of employees of one service or very large department (mechanic service and energetic service managers)	90
6	Responsible for work of several functions in an organization	150
7	Responsible for work of the whole organization	200

Table IV. Responsibility for work

Level	Description	Points
1	Responsible for his/her own health and life (all employees)	7
2	Work connected with health and life danger of other persons (drivers, transporters, electricians)	29
3	Responsible for health and life of employees in one single shift of the department (shift supervisors)	62
4	Responsible for protection of health and life in a manufacturing department (independent service and sections managers)	73

Table V. Responsibility for health and life protection

Strain of sight organs

Processing of hot glass and metal or driving of vehicles leads to fatigue of eyes and raises

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nervous stress. In result of computerization of manufacturing processes, works contributing to strain of sight organs are proliferating in organizations. Therefore, it is necessary to compensate workers for this negative factor (see example in the Table VI).

Level	Description	Points
1	Jobs accomplished without strain of sight organs (blue-collar workers' job)	15
2	Jobs that require large amount of reading and writing (most of the works of white-collar employees, specialists and executives)	30
3	Jobs related to strain of sight organs when constantly observing small objects (cashier, weigher, laboratory assistant)	45
4	Jobs requiring for looking at the luminous monitor episodically (specialists and managers episodically using computers)	60
5	Jobs requiring constant movement and observation of setting (drivers).	75

Table VI. Strain of sight organs

The need for physical energy to complete a job

It obvious that hard physical jobs are not popular. As usual, they are not complicated and do not involve responsibility. Therefore, those jobs according to their complexity and responsibility are not well paid. Work scoring according to physical energy needed to do the work allows paying a proper amount to compensate workers doing hard physical work (see example in the Table VII).

Level	Description	Points
1	Mental work accomplished without using physical energy	15
2	Easy physical work accomplished while seated (bookkeepers and other specialists)	80
3	Easy physical work accomplished while standing and walking (all operators)	120
4	Average hard physical work accomplished in various working stances (equipment repairers)	140
5	Hard physical work (transport workers, navvy, builders)	160
6	Very hard physical work (heavy load transport workers)	180

Table VII. Need for physical energy

Structure of compensation system
In Total Quality Management the same compensation principles should be applied for all workers in an organization (see example of compensation system in the Table VIII).

Wages
In pursuance of perfect work quality of the most effective form of compensation is timework payment system when it is compulsory to accomplish the rate-set task. The wage is comprised of fixed and variable part. (table VIII).

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Compensation		
Material compensation		**Moral compensation**
Wage	Fixed part the amount of which is determined by content of work accomplished at the workplace.	Managerial means of moral influence that create psychological comfort for employees.
	Variable part the amount of which is determined by features of employee and his (her) behaviour at work.	
Bonus premium – special payments	Bonus premium is special payment awarded for a group of persons or an individual person for unique performance that significantly raised profit of the organization or improved quality of the performance that had a positive effect on its profit.	

Table VIII. Structure of compensation system

It is purposeful to establish **the fixed part of wage** using analytical quantitative techniques of work evaluation. Amount of this part should be determined by complexity of the job and specific workplace that conditions qualification required for accomplishment of specific job, nervous stress and strain of vision, physical stress, necessity of confidential information retention and other factors.

Variable part of wage should be established on the basis of personal and specific to work employee' traits and his/her behaviour at work, i.e., *depending on quality of performed work, promptness accomplishing the work, initiative, diligence, versatility and other positive behaviour at work.*

Variable part of wage for work quality should be paid in case the employee accomplishes his work in a qualitative manner and does not hide mistakes made by him or his colleagues and on his own initiative reveals their sources and ways for their elimination and prevention in future, makes suggestions on quality improvement. Variable part of wage for work quality can also be calculated based on indicators of perfect quality settled in accordance with total quality management for every single job. In the latter case, variable part conforming to this indicator should be dependent on degree of approximation to perfect quality.

This variable part should be the most significant one.

Promptness in work accomplishment should be assessed by the direct supervisor of employee and user of his work results.

Initiative and diligence should be assessed by the direct supervisor of the employee. Versatility – i.e., the ability to work in several different jobs in case of manufacture necessity – should also be revealed by the supervisor and formalized by the manager of department.

Bonus premium – special payments

Bonus premium – special payments should be awarded for unique performance that significantly raises profit of the organization or improves quality of its operations. These special payments should not be usual or regular, but particularly exceptional. Some examples of this part of compensation are presented below.

Bonus premium for individual employee or a group of employees is awarded for high-scoring performance, great economic effect (in case of fund economy or when actual profit significantly exceeds the expected one) or when economic effect occurs in the field that is not

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directly connected to job of that employee (group of employees).

Bonus premium for manager is awarded in cases he(she) has successfully improved quality and performance of his colleagues.

Bonus premium for individual employees or creative teams is awarded for engineering projects or results of scientific investigations that essentially improved manufacture processes within their responsibility.

This bonus premium is paid out by two steps. When commission of experts recognizes the project as being real and calculates expected annual economic effect and amount of the premium, advance payment of premium is made. The remaining part of the premium is paid to authors after complete implementation of the project and achievement of concrete economy.

Bonus premium is awarded for authors of new concepts and methods of activity when these developments are accepted for implementation.

Bonus premium for employees is awarded for the achievement of considerable success in marketing and contribution of significant increase of turnover, expansion of the old market or discovery of the new one.

Bonus premium is awarded for individual employees and managers for extraordinary merits when in critical situations organization finds a way out and successfully resolves raised issues.

Amount of the bonus premium is established by Board of Directors depending on the scope and nature of resolved issue.

Bonus premium for employees is awarded when they helped to prevent problems potentially leading to significant losses for the organization.

Conclusion

The special wage administration system development is very important factor in successful implementation of total quality management. Consequently it is necessary to develop theoretical and empirical research programs in this very important total quality management area.

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The role of personal values in
an advanced perspective of Total Quality Management

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Abstract

Purpose: The purpose of this paper is to analyze the relation between personal values and the principles of Total Quality Management and thus to propose a tentative framework of relationships.

Design/methodology/approach: The paper is conceptual. It reviews some lists of values present in literature, and summarizes them in a more comprehensive list. Then it follows the definitions of these values according to some philosophical models, and the analysis of their implications in the business life in general. Thus, tries to explain the relation between them and the principles of TQM, passing through the two mediating variables passion and trust.

Findings: A model of quality management based on personal values is proposed.

Research limitations: The lack of empirical data that can validate the model, and the lack of specific hypothesis of investigation.

Practical Implications (if possible): Considering the emphasis placed on personal values, the model can have some practical implications in the field of recruitment, promotion, and leadership.

Originality/value: The model fills the gap between personal values and the principles of Total Quality Management, being the first attempt to present a comprehensive model of interactions. A novel framework that can provide a basis for further research into the profound nature of quality management has been proposed. Furthermore, some implications that should be useful for recruiters and managers are discussed.

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Introduction and purpose

Professor Amartya Sen, Nobel Prize for Economy, during a speech delivered at the
University of Valencia expressed the following idea about moral codes (1995):
"Moral codes have always been part of the economic mechanism and they are part of the social resources of a community. The modern economy has given up this part of the economic system. There are good reasons to try to change this neglected topic and start reintroducing into the principal stream of economic science this crucial part of economic activity. Eventually, there is still a lot to be done"

It is difficult to find a quotation that better illustrates the importance of reintroducing morality into economic analysis. Kaplow and Shavell (2007) noted that "*the influence of morality on behavior has been a long-standing theme of the analysis of human conduct*", and emphasized that "*recent economic literature on social norms and behavioral economics, …, recognizes that individuals' actions are not always narrowly self-interested and may reflect moral concerns*". Fuqua and Newman (2006) underlined that: "*the highly publicized evidence of corporate scandals and fraud has illuminated the risks of operating a business without substantial emphasis on ethical matters*", and reported that a Yahoo search for "business ethics" generated in 2004 2.130.000 hits, and in 2007 3.280.000 hits, signaling the growing interest in ethics among the public. At present, March 2008, the Yahoo search has counted 11.400.000 hits. The emerging importance of ethics in economy is also reflected in some significant literatures. In this current, one field that is clearly emerging is the role of personal values considering their "*powerful influence on human attitudes, and human behavior*" (Nonis and Swift, 2001) and how they affect economic organizations. As Sosik (2005) noted, "*more recent empirical research demonstrates that values directly affect behavior encouraging individuals to act in accordance to their values*".

Total Quality Management is "*the culture of an organization committed to customer satisfaction through continuous improvement*" (Kanji and Yui, 1997). According to Fisscher and Nijhof (2005), "*quality cannot be managed successfully without an explicit focus on moral values*", because "*on one hand, we need control where quality management tools can be very useful. On the other hand, we need trust from, and moral concern for, the people involved*". Hellsten and Klefsjö (2000) noted that "*the concept of TQM is generally understood, and often also described, as some form of management philosophy based on a number of core values…also in literature named principles, dimensions, elements or cornerstones*". Moreno-Luzon, Peris and Gonzalez (2001) confirmed that "*TQM is based on some essential principles that, implicitly or not, are present both in the theory and in the implementation programs*". Svensson and Wood (2005) underlined that "*the core values of TQM should be built on ethical fundamentals*" because "*customers in the marketplace are becoming increasingly aware of, and increasingly discriminating against, companies that fail to meet the customers' criteria of ethical business activities and management principles*". However, until now no one has explicit and directly analyzed the relation between TQM principles and primary values of the people named to implement the TQM programs. Probably this is due to the fact that personal values have always been considered as "part of the system".
The purpose of this article is to give an answer to the following question: What relationship exists between the general principles of Total Quality Management and primary values*?* The basic point is that primary values are fundamental to the principles of TQM, or better said, personal values could be

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transformed into facilitating elements in order to implement TQM programs correctly and with effectiveness, through two mediating variables: passion and trust. The model that is presented endeavours to fill the existing gap between personal values and the principles of Total Quality Management, being the first attempt to present a comprehensive model of interactions.

Definition of Values and values in economy

Most likely, the largest difficulty for all researchers in the field of values is to find a commonly accepted definition of "value" and a clear distinction between values, principles and virtues. Relevant philosophers (to mention a few: Aristotle, Kant, Kierkegaard, Scheler, Hehlmann, Stalculp, Frondizi, McIntyre), sociologists (Parsons, Williams), psychologists (Rokeach), anthropologists (Kluckhohn), and economists, have presented a definition of values. It is not the aim of this article to introduce another definition, but to underline the general role of values in economy and to present some authors who have introduced comprehensive lists of values relevant to business. Economists have been more interested in the meaning of value as price; nevertheless, some economists have focused on the role of values in business. In this current, we find, among others, Barnard (1958) "*organizations endure, however, in proportion to the breadth of the morality by which they are governed. This is only to say that foresight, long purpose, high ideals are the basis for the persistence of cooperation*", Berntahl (1962) "*values lead and direct businessmen in their decision making processes*" McMurry (1963), "*If management is to cope successfully with its people problems, it must take into greater account than it usually does the roles played by values*", Guth & Tagiuri (1965) "*the values that are most important to an executive have a profound influence on his strategic decision*", England (1967), "*the personal value systems of individual managers influence the organization...personal values systems are influenced by organization life*", England and Lee (1974), "*There is a real and intrinsic relationship between the level of success achieved by managers and their personal values*", and finally, McDonald and Gandz (1991), "*A literature review indicates that values impact a wide spectrum of organizational effectiveness including the following: Strategic Decision-Making, Corporate Ethics, Operational Decision-Making, Interpersonal Conflict, Quality of Working Relationships, Career Choice and Progression, Employee Motivation and Commitment*". Regarding the lists of values present in literature it is interesting to note the nonexistence of a universally recognized list of "primary values", the values most relevant to individuals. This situation is due to the fact that the preparation of a list is always influenced by various subjective and social elements. It could be affirmed that the elaboration of a list of primary values is affected by the values of the redactor! Table I contains some list of values present in literature.

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TABLE I: Summary of some lists of values present in literature

McDonald (1991)	England (1967)[1]	Rokeach[2] (1973)	Learned (1959)	Beekun (2005)	Williams (1997)	Kriger, Seng (2005)	Nonis and Swift (2001)	Den Hartog et al. (1999)	Jurkiewicz Giacalone (2004)	Reave (2005)	Bird and Waters (1987)
Cooperation	Ambition	Honesty	Love	Benevolence	Efficiency	Forgiveness	Security	Positive	Benevolence	Integrity	Honesty in communication
Diligence	Ability	Trust	Relations		Community	Kindness	Self Respect	Trustworthy	Generativity	Honesty	Fair treatment
Integrity	Obedience	Humility	Justice		Liberty	Integrity	Being respected	Informed	Humanism	Humility	Special consideration
Openness	Trust	Forgiveness				Compassion/empathy	Self-fulfillment	Just	Integrity	Respect for others	Fair competition
Initiative	Aggressiveness	Compassion				Honesty/truthfulness	Sense of belonging	Win-win problem solver	Justice	Fair treatment	Organizational responsibility
Experimentation	Loyalty	Thankfulness				Patience	Excitement	Encouraging	Mutuality	Caring and concern	Social responsibility
Aggressiveness	Prejudice	Being of service		Trust		Courage/inner strength	Fun and enjoyment	Intelligent	Receptivity	Listening	Respect for law
Fairness	Compassion	Peace		Justice	Equality	Trust	Warm relationships	Decisive	Respect	Appreciating others	
Adaptability	Skill	Clemency				Humility	Sense of accomplishment	Administratively skilled	Responsibility	Reflective Practice	
Creativity	Cooperation	Tranquility				Loving kindness		Effective Bargainer	Trust	Work as spiritual calling	
Development	Tolerant					Peacefulness		Foresight			
Courtesy	Conformity					Thankfulness		Plans ahead			
Cautiousness	Honor					Service to others		Motive arouser			
Equality						Guidance		Communicative			
Economy						Joy		Excellence Oriented			
Consideration						Equanimity		Confidence Builder			
Formality						Stillness/inner peace		Honest			
Humor								Dynamic			
Forgiveness								Coordinator			
Broad-Mindedness								Team Builder			
Logic								Motivational			
Autonomy											
Obedience											
Orderliness											

The above lists can be finally summarized in a more comprehensive list able to be related to TQM principles (See table II). The list has been elaborated with the help of experts in the field of values from different disciplines (especially philosophy and theology). In some cases, it was necessary to compromise and enlarge the meaning of the words, but it was always done respecting the semantic of the words. The resultant values are not filed per "importance" but based on the "quantity of resemblances".

TABLE II: The Primary Values

McDonald (1991)	England (1967)	Rokeach (1973)	Learned (1959)	Beekun (2005)	Williams (1997)	Kriger, Seng (2005)	Nonis and Swift (2001)	Den Hartog et al. (1999)	Jurkiewicz Giacalone (2004)	Reave (2005)	Bird and Waters (1987)
LOVE											
Forgiveness Adaptability Courtesy Cooperation Consideration	Tolerant Compassion Cooperation Trust	Clemency Being of service Thankfulness Compassion Forgiveness Trust	Love Relations	Benevolence Trust	Community Liberty	Service to others Guidance Compassion/Empathy Thankfulness Forgiveness Trust Loving kindness Kindness	Being respected Self Respect Warm relationships Sense of belonging	Trustworthy	Humanism Generativity Mutuality Respect Benevolence Trust	Respect for others Fair treatment Caring and concern Work as spiritual calling Listening Appreciating others	Special consideration Fair treatment
HONESTY											
Integrity Cautiousness	Honor Loyalty	Honesty				Honesty/truthfulness Integrity		Honest	Integrity Responsibility	Honesty Integrity Reflective Practice	Honesty in communication
JUSTICE											
Fairness Equality			Justice	Justice	Equality	Equanimity	Security	Just	Justice		Fair competition Respect for law
PEACE											
Humor		Tranquility Peace				Joy Stillness/inner peace Peacefulness Patience	Fun and enjoyment Excitement	Positive			
INITIATIVE											
Initiative Diligence Creativity Autonomy Economy Aggressiveness	Aggressiveness Ambition					Courage/inner Strength	Sense of accomplishment	Win-win problem solver Intelligent Encouraging Decisive Motive arouser Effective Bargainer Dynamic			
COMPETENCE											
Development	Ability Skill				Efficiency		Self-fulfillment	Informed Administratively skilled Communicative Motivational			
VISION											
Experimentation Logic Broad-Mindedness Openness								Excellence Oriented Foresight Plans ahead			Organizational responsibility
HUMILITY											
		Humility				Humility				Humility	
FORMALITY											
Obedience Formality Orderliness	Conformity Prejudice Obedience							Coordinator Team Builder Confidence Builder	Receptivity		Social responsibility

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[1] Only "Ideas associated with people"
[2] As elaborated by Kriger and Hanson, 1999

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The principles of TQM

Total Quality Management is defined as "*one such philosophy, which aims to provide organizations with a template for success through customer satisfaction*". (Mosadegh Rad, 2006). According to Lagrosen and Lagrosen (2006), quality management is "*an entity consisting of three separate layers of increasing profundity...the first ...level consists of a number of practical tools and techniques...on the second level, we find an array of more comprehensive models and systems...the third level contains the phenomena that are referred to as values, principles, or cornerstone of quality management*".
Hellsten and Klefsjö (2000) introduced a table including the core values (or principles) of three quality awards: Malcolm Baldrige National Quality Award, European Quality Award, and the Swedish Quality Award.
Moreno-Luzon, Peris and Gonzalez (2001) introduced the specific and generic principles of TQM and affirmed that these principles lead the implementation of TQM programs. Table III summarizes the TQM principles/core values from literature.

Table III: Principles and Core Values of Total Quality Management			
Moreno-Luzon, Peris y González	**Malcom Baldridge National Quality Award**	**European Quality Award**	**The Swedish Quality Award**
SPECIFIC PRINCIPLES	*CORE VALUES*		
Customer orientation	Customer-driven quality	Customer focus	Customer orientation
Committed leadership	Leadership	Leadership and consistency of purpose	Committed leadership
Participation and involvement by all		People development and involvement	Participation by all
Cultural change			
Internal cooperation			
Teamwork			
Partnership development	Partnership development	Partnership development	Partnership
Training			Learning from others
Management by facts	Management by facts	Management by process and facts	Management by facts
Design and conformity of process and products	Design quality and prevention		Prevention
Process orientation			Process orientation
Continuous improvement	Continuous improvement and learning		Continuous improvement
GENERIC PRINCIPLES			
Global perspective	Long-range view of the future		
Long-range objectives			Long-range perspective
Shared vision			
Organizational climate			
Organizational learning			
Results orientation	Results Focus	Results orientation	
Necessary means			
Organizational structure			Competence development
	Public responsibility and citizenship	Public responsibility	Public responsibility
	Valuing employees		
	Fast response		Faster response

It is now possible to extract the principles that occur more frequently than others and focus only on those TQM principles that can be directly affected by the values of the individuals called upon to implement the TQM programs:
  (1)   Customer orientation;
  (2)   Leadership commitment;

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(3) Participation and involvement by all;
(4) Partnership development;
(5) Continuous improvement and learning;
(6) Long-range perspective,

and analyze the relationship between these principles and the primary values stemming from table II.

The relationship between primary values and TQM principles

If the primary values are ignored, the TQM will not be implemented correctly because of lack of necessary motivation of those called upon to implement these programs. In other words, primary values permit internalization of the TQM principles and the overcoming of the resistance to change. In fact, as Mosadegh Rad (2006) noted, "*numerous studied carried out have shown that human resources problems are important barriers in implementing successful TQM…furthermore, employee involvement and commitment to the goals of the TQM process are critical in TQM success*". Also Lagrosen y Lagrosen (2006) "*...the most effective way to achieve profound and long-lasting changes in organizational behaviour is through a change in consciousness...*", Camisón, Cruz, González (2007) "*...the biggest problem of TQM implementation is that these programs have not been able to change all the organization system, always forgetting to impact and modify the human and social relations*", and Conti (2005) "*...while the most tangible aspects of the TQM models were generally accepted, the intangible were hard to digest*".

Lagrosen y Lagrosen (2006) noted that "*quality management has grown from some simple control techniques into a system of improvement that involves the entire organization*" whereas Ravlin y Meglino (1998) underlined that "*...value congruence with the organization clearly indicate that perceived congruence relates positively to affective outcomes, including satisfaction, commitment, and involvement*". Finally, St. Thomas noted that "*values generate principles*".

Based on these premises, the hypothesis is that a TQM program based on principles should be founded on the personal value systems of the people in the organization, or better said, personal value systems represent the necessary facilitating elements to implement the TQM programs correctly and effectively.

In the following sections the relationship between each primary value and the TQM principles will be analysed.

(a) Relationship between the primary value "love" and TQM principles

According to Plato, "*Good people do not need laws to tell them to act responsibly, while bad people will find a way around the laws*", in other words, where loves reigns, laws are unnecessary. In a workplace characterized by love, personalities and protagonists totally disappear, replaced by trust, passion, reciprocal respect and individual care. In a workplace were love reigns, all the members of the organization are capable of self-regulating the activities, and all the norms become superfluous. Love means being tolerant, benevolent, cooperative, compassionate, grateful, forgiving, kind, respectful and finally, having a certain level of empathy with others. Love can affect all the TQM principles.

TABLE IV: Relationships between the "love" and the TQM principles	
PRIMARY VALUE	**TQM PRINCIPLES**
LOVE	Customer orientation Leadership commitment Participation and involvement by everybody Partnership development Continuous improvement and learning Long-range perspective

(b) Relationship between primary value "honesty" and TQM principles

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Honesty is a human quality consisting of behaving with integrity, transparency, and sincerity. Honesty means recognizing facts as they are without distorting reality. Honest people do not lie, do not prepare snares, do not steal, and do not manipulate reality. Honesty is the engine of social relations and business. Becker (1998), although noting that scholars have confused integrity with other concepts (especially honesty and conscientiousness), recognizes that "*honesty is a necessary but not sufficient condition for integrity...*" and affirms that "*employees with higher integrity are better workers than those with lower integrity...therefore, ceteris paribus, organizations having more employees with high integrity are more likely to survive and thrive than are organizations with fewer such employees*".

Therefore honesty is merely one component of the larger picture. It is a necessary but not sufficient condition to define the *Integer Homo*. Honesty can affect the following TQM principles:

TABLE V: Relationships between the "honesty" and the TQM principles	
PRIMARY VALUE	**TQM PRINCIPLES**
HONESTY	Customer orientation Leadership commitment Participation and involvement by everybody Partnership development

(c) Relationship between primary value "justice" and TQM principles

The word Justice stems from the Latin word *iustus* that derives from *ius* that means fair, right. Justice is the complete set of norms that regulate relations between people and institutions, authorizing, forbidding, and allowing specific behaviours. Justice does not mean sharing things with all mankind. It consists of defining what and who is right. Justice in workplace generates healthy competition because everyone knows that he will receive what he is entitled to. Justice should be related to Love and Honesty. The organization that lacks respect and transparency will also lack justice. Reave (2005) indicates that "*justice and fairness are values important to most spiritual paths...Two recent surveys...found that the highest priority for employees was fairness at work*". So justice erases individualisms, egoisms, and lies because everyone knows that equality and impartiality will always prevail. Justice can affect the following TQM principles:

TABLE VI: Relationships between the "justice" and the TQM principles	
PRIMARY VALUE	**TQM PRINCIPLES**
JUSTICE	Leadership commitment Participation and involvement by everybody Partnership development

(d) Relationship between primary value "peace" and TQM principles

Peace is the predisposition to know oneself and one's capacity to create and be part of a social network. Peace implies an interior and exterior cheerfulness, and is an emotional stability that allows one to face daily challenges with positive soul and, especially, allows for solving problems instead of creating new ones. Peace needs daily efforts to solve problems without being submitted to the difficulties. Peace determines solidarity, consolation, cooperation within the group. Peace can affect the following TQM principles:

TABLEVII: Relationships between the "peace" and the TQM principles	
PRIMARY VALUE	**TQM PRINCIPLES**
PEACE	Customer orientation Leadership commitment Participation and involvement by everybody Partnership development

(e) Relationship between primary value "initiative" and TQM principles

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Initiative is the result of something that occurs internally and that is constantly stimulating one in order to anticipate events, and to be always proactive. It is directly related to peace. If there is no peace, creativity dies. The chairman and CEO of Levi Strauss and Co., Robert Hass, interviewed by Howard (1990) noted that "*at Levi, we talk about creating an "empowered" organization... It has to be the strategy and the values that guide them...the more you establish parameters and encourage people to take initiatives within those boundaries, the more you multiply your own effectiveness by the effectiveness of other people*". Initiative can affect the following TQM principles:

TABLEVIII: Relationships between the "initiative" and the TQM principles	
PRIMARY VALUE	**TQM PRINCIPLES**
INITIATIVE	Customer orientation Leadership commitment Participation and involvement by everybody Partnership development Continuous improvement and learning

(f) Relationship between primary value "competence" and TQM principles

Competence consists in knowing how to do something and it is strictly linked to "knowledge". Considering that activities in the workplace are always the result of a specific form of learning and training, competence necessarily became a must. Trigo (2006) noted "*studying is a virtue that leads and moderates – according to the reason – the desire to know...the objective of this virtue is not the knowledge as such. This virtue provides to the man an honest desire to know the truth and to use it fairly...*". Nonaka and Takeuchi (1995) underlined that "*...it is the ability to create new knowledge continuously that becomes the source of competitiveness in the knowledge society*".
The worker who uses his "competence" in a right and honest way is a resource for a company, especially in the case of implementing TQM programs. Competence can affect the following TQM principles:

TABLE IX: Relationships between the "competence" and the TQM principles	
PRIMARY VALUE	**TQM PRINCIPLES**
COMPETENCE	Customer orientation Leadership commitment Participation and involvement by everybody Continuous improvement and learning

(g) Relationship between primary value "vision" and TQM principles

Vision consists in seeing beyond others. Vision means to investigate new things, to open one's mind and, sometimes, to dream. Vision should be part of the background of all the workers, starting from the CEO who has to define the strategy, to the man at the machine who has to imagine new ways to do things, always in search of excellence. Vision is the value that leads in this search. Vision is never related to the present. It is where one wants to be in the credible future according to his or her possibilities. Vision can affect the following TQM principles.

TABLE X: Relationships between the "vision" and the TQM principles	
PRIMARY VALUE	**TQM PRINCIPLES**
VISION	Customer orientation Leadership commitment Participation and involvement by everybody Partnership development Continuous improvement and learning Long-range perspective

(h) Relationship between primary value "humility" and TQM principles

Probably the value "humility" is one of the most represented in management literature. Reave (2005) noted "*humble leaders who stay in the background are often the most effective*". Collins (2001), in his study of extraordinary performance achievements in good-to-great companies, found that "*Level 5 leaders are a study in duality: modest and wilful, humble and fearless*". Vera y Rodriguez-Lopez (2004) argued

"humility offers strategic value for firms by furnishing organizational members with a realistic perspective of themselves, the firm, and the environment". In other words, humility is the virtue of realism. It consists of being aware of limitations and insufficiencies and behaving in accordance with this knowledge. More precisely, humility consists of self- recognition. Saint Theresa of Avila affirmed that "*humility represents the truth*", meaning that humble individuals always see things as they are, the good as good, and the bad as bad. The more humble, the better the vision of reality. Kallasvuo (2007), president and CEO of NOKIA, noted "*humility is a vital quality in a leader, just as it is for a company…It gives you the strength to resist the safe conformity of benchmarking and instead try to think differently. It allows you (in fact compels you) to say that things have changed, and we need to change, too*". Humility can affect the following TQM principles:

TABLE XI: Relationships between the "humility" and the TQM principles	
PRIMARY VALUE	**TQM PRINCIPLES**
HUMILITY	Customer orientation Leadership commitment Participation and involvement by everybody Partnership development Continuous improvement and learning

(i) Relationship between primary value "formality" and TQM principles

Formality means both how to organize things and how our interior is organized. If we put the man as the centrepiece of the organization, he should have the necessary formality to organize himself and his things in order to be able to implement TQM principles correctly. Formality guarantees that people with values remain "in the organization" and do not act outside its boundaries. Formality can affect the following TQM principles:

TABLE XII: Relationships between the "formality" and the TQM principles	
PRIMARY VALUE	**TQM PRINCIPLES**
FORMALITY	Customer orientation Leadership commitment Participation and involvement by everybody

Table XIII summarizes the relationships between primary values and TQM principles.

TABLE XIII: Summary of Relationships between the "Primary Values" and the TQM principles						
	Customer Orientation	Leadership Commitment	Employees Participation	Partnership development	Continuous Improvement	Long-Range Perspective
Love	YES	YES	YES	YES	YES	YES
Honesty	YES	YES	YES	YES		
Justice		YES	YES	YES		
Peace	YES	YES	YES	YES		
Initiative	YES	YES	YES	YES	YES	
Competence	YES	YES	YES			
Vision	YES	YES	YES	YES	YES	YES
Humility	YES	YES	YES	YES	YES	
Formality	YES	YES	YES			

The mediating variables: passion and trust

Passion and Trust are the results of living primary values that, at the same time, influence directly and with different intensity the principles of TQM more related to persons. The two variables are well-analyzed in literature at different intensities. Hosmer (1995) defines trust as "*the expectation by one person, group, or firm of ethically justifiable behavior – that is, morally correct decisions and actions based upon ethical principles of analysis – on the part of other person, group, or firm in a joint endeavor or economic exchange*", and emphasizes that trust can be composed of five specific components: integrity, competence, consistency, loyalty, and openness. Schoorman, Mayer and Davis (2007) contend

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that "*all three factors of ability, benevolence, and integrity can contribute to trust in a group organization*", whereas Jones and George (1998) assert "*values contribute to the generalized experience of trust and can even create a propensity to trust that surpasses specific situations and relationships*". According to Pelligra (2007), "*when trust reigns in a community, progress flourishes in all its forms, including social, political, and economic*".

Passion has been analyzed in different forms. The most common are to consider passion as *commitment* or *enthusiasm*. According to Lee and Miller (1999) "*employees who are committed and dedicated to their firms, are more apt to work in harmony towards the same strategic objectives and to make decisions with care and generosity of spirit*". Passion is more than enthusiasm and commitment. Jones (2001) noted "*passion develops from a long-term commitment. It happens when you are taking actions that make a difference to something that provides you with meanings*". It is a source of intrinsic energy that allows making a strong link between what one does and what he or she believes in. Schwartz (2007) emphasized that energy "*comes from four main wellsprings in human beings: the body, emotions, mind, and spirit*". Boyatzis, McKee and Goleman (2002) noted that "*when asked, most businesspeople say that passion – to lead, to serve the customer, to support a cause or a product, is what drives them. When that passion fades, they begin to question the meaning of their work*". Klapmeier (2007) asserted "*you have to have passion to do something industry changing…you also need it to get you through all the setbacks*". Jones (2001) reported "*the people I interviewed talked about the benefits of work passion in two major themes: their own rewards, and rewards for the organization*". Finally, Milne (2007) noted "*if people are passionate about what they do, they'll be happier and more productive. Just as importantly, they'll infect customers and co-workers with their positive attitude and stay longer with the company*".

So, the leading idea is that living primary values helps to generate passion and trust. In particular:
- Love, because of its contribution to the elimination of individualities, protagonism, and egoism, generates passion and trust;
- Honesty, because of its contribution to reciprocal respect, generates passion and trust;
- Justice, directly related to honesty, affects trust;
- Peace, responsible for creating internal and external joy and harmony, and predisposed to solving problems, generates passion and trust;
- Initiative, representing the internal force to act, generates passion;
- Competence generates passion because of eagerness always to learn more, and trust because one trusts people whom one knows;
- Vision affects passion and trust because all members share the same objectives;
- Humility generates trust because of the possibility to correct bad habits;
- Formality generates trust because it guarantees harmonious movement within the organization.

Table XIV: Relationships between values and mediating variables		
	Passion	Trust
Love	YES	YES
Honesty	YES	YES
Justice		YES
Peace	YES	YES
Initiative	YES	
Competence	YES	YES
Vision	YES	YES
Humility		YES
Formality		YES

The interaction model

Dean and Bowen (1994) define Total Quality as "*a philosophy or an approach to management that can be characterized by its principles, practices, and techniques*" and emphasize that Total Quality "*has come to function as a sort of Rorschach test, to which people's reactions vary as a function of their own beliefs and experience*". Tarì (2005) noted "*the literature has pointed out that TQM and human resources management go hand in hand, the latter being the basis for part of the important success of TQM.*

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Nevertheless, practice shows a lower interest in the human side. At times, it has been found that TQM success depends critically on human aspects". Dahlgaard and Dahlgaard-Park (2006) stressed the importance of understanding the human factor; "*the first aim of a quality strategy is to build quality into people through strengthening of both Core Vales (CV) and Core Competencies (CC)...if CV are ignored...the company will not be able to utilize the CC, which they try to build into people. Trust, respect, benevolence, integrity, loyalty, justice and honesty are some identified elements, which can be categorized by the term CV*". Sosik (2005) noted "*more recent empirical research demonstrates that values directly affect behavior by encouraging individuals to act in accordance to their values*". Drury (2003) noted "*it appears that human factors and the quality movement can work well together and have much to offer each other by cooperation*". Schwartz (2007) proposes a new contract between organizations and employees "*we envision a new and explicit contract that benefits all parties: organizations invest in their people across all dimensions of their lives to help them build and sustain their value. Individuals respond by bringing all their multidimensional energy wholeheartedly to work every day. Both grow in value as result*".

Figure 1 explains the interaction model between Primary Values and TQM principles. The hypothesis is that the living of primary values generates passion and trust among workers that help to reduce the values conflict that generates cognitive dissonance (Moser 1998) and, consequently, tempers the introduction of TQM programs both by establishing cognitive harmony and by building a sense of shared objectives. Finally, the cognitive harmony will have a positive impact on productivity and job performance which, in some circumstances, can have a significant impact on corporate financial performance.

Figure 1. MODEL OF RELATIONSHIPS BETWEEN PRIMARY VALUES AND TQM PRINCIPLES
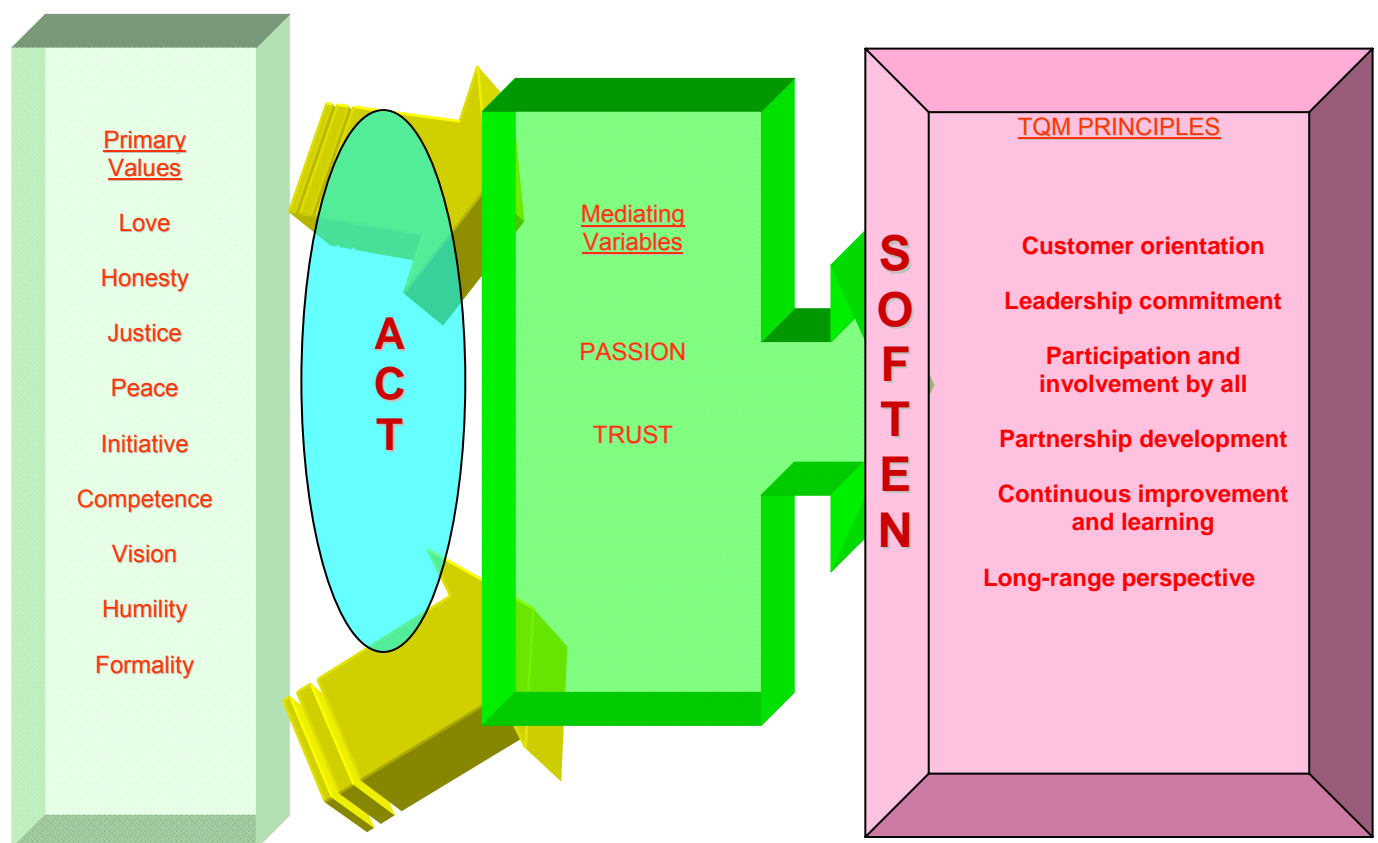
Managerial Implications

According to Brown and Treviño (2006) "*individuals are attracted to, and are selected into organizations on the basis of perceived person-organizational values fit*". Barsade, Ward, Turner, and Sonnenfeld (2000) noted that "*this fit is important because...people care about how similar they are to others on a variety of dimensions... people prefer to interact with other individuals or groups who have (or are*

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perceived to have) attitudes and values similar to their own". England end Lee (1974) emphasized "*value patterns predict success and could be used in making selection and placement decisions*". Therefore, the first managerial implication is that organizations should clearly state the values of the company, look for values assonance during the recruiting process and continuously verify and stimulate the person-organizational values fit. The objective should be, as Dean and Bowen (1994) stressed, on "*focusing on the selection of a "whole" person (i.e., not just technical skills, but also personality traits and needs) who will fit not only specific job requirements, but also the unique characteristics of the overall organization*". Parish, Cadwallader, and Busch (2008) noted "*as managers make decisions for coping with change, they must consider not only how firm performance will be affected but also how employees will be affected*" introducing the second managerial implication: the need to evaluate, when introducing changes, how the human factor will be affected and introduce the needed interventions.

Finally, managers should begin focusing on the spiritual needs of the workers because as Dahlgaard and Dahlgaard-Park (2006) noted, "*only the satisfaction of both mental and spiritual needs, will make man happy and content*".

Conclusions

It seems clear that personal values can play an important role in the implementation of TQM programs, being the stimulators of workers' motivation. This paper represents the first attempt to integrate into TQM theory the values of people called upon to implement TQM programs. The contributions are the following: presentation of a summary of values list in literature and primary values detection, presentation of a summary of TQM principles both from literature and quality awards, introduction of the leading idea that passion and trust are the results of living the primary values and presentation of a theoretical model of relationship between primary values and TQM principles.

This being a first attempt, it may contain some limitations. In particular, it is important to underline the difficulties of moving among different fields of study (ethics, philosophy, psychology, religion, etc.), the difficulty of defining with exactitude the variables of the model, the inexistence of empirical data to validate the model, the inexistence of a clear and unique terminology, sometimes also with difficulty of comprehension and, finally, the inexistence of specific hypothesis of investigation.

For the future, the relationships between primary values and TQM principles should be analyzed in depth, aided by companies that are already implementing TQM programs based on values. The validation of the role of Passion and Trust based on research results and the measurement of the intensity among the variables of the mode should be evaluated.

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IMPACT OF EMOTIONAL INTELLIGENCE ON QUALITY OF SERVICE IN SOFTWARE INDUSTRY OF PAKISTAN

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ABSTRACT

Most of the software organizational trainings are focused on improving the technical skills and rightly so. Contemporary training curriculum needs to encompass programs which are focused on improvement in interpersonal relationships classified as soft skills. The importance of Emotional Intelligence (EI) becomes eminent when we consider the businesses which mainly depends upon knowledge workers, lets say; Software People. Since EI is important for recognizing one's own feelings and those of others, for self motivation and for managing emotions in ourselves and in our relationships. The research has been conducted to see the link between organizational EI and their quality of service.

PURPOSE

Rationale behind the research is to underline the importance of Emotional Intelligence in software industry of Pakistan and how it can contribute positively towards organizations quality of service, which ultimately leads to organizational success. Unfortunately anything which is related to improving the social / interpersonal skills is given low-priority and usually paid little attention. Management has to realize the fact that investing on developing soft skills and Emotional competencies among the employee's would certainly give them strong financial gains in the longer run. Organization has to exhibit long term dedicated commitment in order to gain the constructive outcome from these trainings.

RESEARCH METHODOLOGY

EI related questionnaires targeting job related EI and general EI awareness were circulated in different organizations. Personal interviews to assess Knowledge, Awareness and Practices (KAP) were also conducted to evaluate the impact of EI on the Quality of Service.

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FINDINGS

This research has explored the following core areas:

I. EI has meaningful impact on the performance of Human Resource
II. Higher the level of awareness greater the performance
III. Increased EI correlates with profitability via Customer Satisfaction
IV. EI can inculcate quality that improves customer satisfaction

Detailed findings can be found under the Analysis and Finding section.

VALUE OF THE PAPER

This research aims to add value by instilling the EI culture in software organization by proposing this model; improved EI culture, better the quality of service, greater the customer satisfaction.

KEYWORDS

Emotional Intelligence, Quality of service, Communication Gap, Motivation, Software Engineer, KAP.

PAPER TYPE

Research Paper

RESEARCH SCOPE

The scope of our research is limited to Export Focused Pakistan based and Foreign Software organizations located in Pakistan.

INTRODUCTION

The discipline of Software is considered more of a science than an art where the word "Software Engineering" is still debatable. Being more of an intellectual activity a Software engineer has the utmost need of sound personal EI skills to use the proposed frameworks and techniques.

Being relatively younger than other disciplines and its distinctive nature there are many intrinsic issues such as absence of accurate estimations strategies. Usually software engineers spend more time with their computers which results in a decreased interpersonal communication. Such communication gaps result into de-motivated human resources exhausting all their efforts in an un-optimized way just to meet the unrealistic goals. Issues like lack of motivation, inability to work along with others, lack of trust, increased dysfunctional conflict, Turnover, decreased loyalty are a result of the prevailing low EI culture at workplace.

Improved quality of the process results in customer satisfaction leading to profitability (benefiting the stakeholders of the company including the employees). Being emotionally intelligent improves not only self-awareness but also harmonizes and organizes the surrounding environment. Good team communication, being able to empathize, intrinsically motivated, self-managed and refined social skills come handy in such environments.

Hypothesis examined in this research study are as follows:

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H1 Higher the level of Emotional awareness at organizational level greater will be the performance.

This hypothesis intended to reveal the awareness regarding emotional capacities of employees within the software organizations.

H2 Increased Emotional awareness correlates with high financial gains through customer satisfaction.

The intent of this hypothesis is to study the influence of emotional intelligence culture in the form of customer satisfaction that ultimately results in monetary gains.

H3 Emotionally intelligent culture results in employee satisfaction, which results in better Quality of Service.

This hypothesis intended to correlate the level of QoS achieved by the organization with the level of emotional intelligence employees of that organization possess.

RESEARCH OBJECTIVE

This research intends to judge employee satisfaction by calculating the EI level of employees working in the software organizations. Usually the level of Quality of service of an organization is judged by the customer satisfaction surveys, but this research approaches the measurement of organization's service quality by measuring the employee satisfaction level in the organization. The idea is that organizations having satisfied employees due to better EI level will have relatively better QoS. In other words, this research will discover the active correlation between Organization's EI level and its QoS.

INDIVIDUALS EMOTIONAL INTELLECT DEVELOPS ORGANIZATION'S EMOTIONAL INTELLIGENCE CULTURE.

Individuals are key resources of any service sector organization. State of the art technology alone cannot guarantee for organizational success. Major contributor is human resource. Right people doing desired jobs in likable work environment generate unexpected levels of performance (judged by quantity and quality) reflected in terms of market standing of the organization.

Studies over the last decades have proved that only IQ alone does not ensure success in life. Five components of Emotional Intelligence (SELF AWARENESS, SELF REGULATION, SELF MOTIVATION, SOCIAL AWARENESS, SOCIAL SKILLS, and RELATIONSHIP BUILDING) as identified by Goleman address initially about the individual's self. Once the emotional stability is achieved that will automatically result in the development of social skills for the purpose of survival **"*EI is not a journey with a clear path, not one that should be embarked upon lightly," (Smewing, 2004, p. 67)*.** An individual who understands his/her own emotions and knows well how to reflect them can successfully judge the emotional status of the other people around. While working in intellect-based industry like software organizations, people work in teams to bring an idea to reality from something which can not be touched and felt, but was only perceived by human mind. Translation of what an individual thinks about/of an application can be possible only if the individual is expressive. Requirement elicitation is important part of Software Development Life Cycle (SDLC) where customer requirements are translated by the (Business Analysts) software professionals. Communication skills of the software

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professional here are of utmost importance to communicate, understand and translate what the customer wants and then get the satisfaction of the customer on "what's translated is actually what's needed". This communication ability is deeply impacted by the state of mind of the communicating party (customer services, business development) on whom the whole business deal relies in terms of attracting a new client for the business or retaining the already existing clientele.

One aspect of organizational success is the level of communication skills its employees reflect apart from providing the state of the art product and services. These communication skills mainly involve the profound understanding of dealing with human minds through the art of convincing, Understanding (capturing actual requirements), and then properly translating them to actual product or service.

The skill of handling people resides on the Emotional Intellect of the individual. Higher the EI level better is the communication abilities. Luckily, unlike the IQ, EI can be improved through training.

Mental satisfaction plays an important role in having stable emotional state. While working in software organizations late sittings, stretched deadlines, feature creep due to change requests and their accommodation in the developing product in limited available time is a norm nowadays. Such hectic and demanding work routines can easily stress out individuals who are part of this whole SDLC. This could bring disturbed emotional state of mind, which finally impacts the performance and quality of the work produced. Even very unnoticeable stress, situations greatly impact the quality of the product and services delivered. Therefore, this can be taken as a ripple effect; where every single factor affecting every single individual involved since the initiation of the software product till the marketing and customer dealings piles up to impact the quality of the outcome.

Social Interaction in the work environment is part of day-to-day organizational life. These social interactions are among the peers, manager and the team members, top management with the technical resources.

Mutual interactions desire understanding and coordination. Managers can play an important role to keep their task force motivated and devoted. As the people grow to be at supervising positions in organizations, the need of understanding people becomes stronger. *"Many managers are not aware of how to assess emotional intelligence of their staff members or the job applicants," (Fleming, 1999, p. 26).* A Workplace where people communicate well, understand each other, empathize and work along in strong bonds has its name in top organization lists.

Factors like de-motivation, dissatisfaction with job and turnover usually arise when people feel themselves as a misfit in their surroundings or when they are not acknowledged for their work, they feel that their contribution is worthless for organization. Managers have to consciously consider the soft skills, emotional intellect and personality type of the individuals apart from their technical expertise, academic performance and analytical abilities while inducting them into the organization. *"It all might seem a bit too 'New Age' for hard-nosed business executives focused on the bottom line, but emotional intelligence is increasingly being regarded as a valuable people skill*

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that distinguishes the top-performers from average staff," (Beagrie, 2004, p. 1). Individual's assertive behavior, learning attitude and sufficient IQ indicates if they can be emotionally developed. According to Goleman *"Simply being high in emotional intelligence does not guarantee that a person will have learned the emotional competencies that matter for work; it means only that they have excellent potential to learn them" (Goleman, 1998, p. 25)*

For Emotional awareness to become a part of organization's culture it has to be actively practiced by the Top management *"EQ starts at the top. The mind of an organization is really an amalgam of the mind-sets of the people who work there. It's a collective mind. If an organization has people in leadership roles who display emotional intelligence that generally will make the organization more that way" (Miller, 1999, p. 29)*

JUDGING QUALITY OF SERVICE THROUGH EMPLOYEE SATISFACTION OR EMPLOYEE SATISFACTION CONTRIBUTES TOWARDS IMPROVED QUALITY OF SERVICE

Quality gurus like Deming, Juran and Crosby emphasize quality improvement in terms of institution of Training and Leadership, driving out fear, optimization of team efforts, pride in workmanship and encouragement of education as self-development among the employees are among the keys to achieve quality in its totality.

It can be very well mapped from the perspectives and philosophies of quality gurus that quality is not a destination it's a journey towards continuous improvement since nothing is perfect.

In order to satisfy the customers, the devoted involvement of employees serving the organization is as much important as understanding the customer's needs and desires and there proper translation. Quality of service is usually gauged by the response of customers. Customer satisfaction is the striving factor causing improvements in the service. But in order to achieve that customer satisfaction level organization must define quality standards that need to be achieved. Availability of established criteria against which quality of work can be judged and evaluated ensures quality. Therefore, this calls for the involvement of Top management in instigating and cultivating quality standards within the organization. In this case, employees know what are they expected to do and what's the quality desired of their work, so they automatically strive to achieve it. Anything not communicated and pre assumed by the management does not help to improve, since individuals and teams remain unsure what's asked of them, so this may cause variety of standards to exist in the organization, varying from team to team. As all the departments are directly or indirectly involved in the development of the software, every department's output is input to another department so it's a cyclic process. The incompatibility of the quality standards and evaluation criteria in various departments ultimately impacts the outcome; product or a service.

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ANALYSIS & FINDINGS

We circulated an online survey to different organization targeting general EI and EI standing at organizational level. All of the respondents were part of the SDLC in different capacities. Below are the brief survey details

Total No. of Respondents	100
Male to Female Ratio	80 : 20
Total No. of Organizations	9
Average respondent Experience	4.5 Years

I.   Handling human emotions is not simple job because each individual have their own attitude and values. Retaining a knowledge worker is the supreme challenge that every software organizations are facing nowadays. This Significance increases as the nature of the business becomes more technical. It is clearly visible from results that clashes with immediate supervisor turn out to be one of the foremost issue software organization are currently struggling with.

II. Apart from technical and analytical abilities, significance of EI becomes utmost important when working in team environment. Results validate that even though a technically sound individual with high IQ but having Low or average EQ can certainly never be a good team player.

III. The terms of Emotional intelligence is even though a buzzword now days in international arena but in the software industry of Pakistan, we found that the awareness of emotional intelligence is comparatively far across. Majority of the Managers and Team leads we interviewed unfortunately had a misconception regarding the definition of Emotional Intelligence. They think EI and common sense are two different names of a single entity whereas when compared with fresh graduates or person having 2 to 3 years of experience they were well aware of the subject.

IV. Our research is based on the hypothesis that Emotional Intelligence has a direct correlation with employee satisfaction. Respondents endorsed the hypothesis that inculcating EI culture in the organization can effectively help in achieving overall job satisfaction. When an individual is contented enough, mentally relaxed with his/her job and surrounding environment only then he/she innovates. Majority of the respondent of our survey agreed that EI can drive innovation and Innovation comes from investing in EI. It has been concluded, "Innovation is the by-product of a motivated employee". Although some thought that, other resources are also required by a person to become innovative. By and large they considered EI to be an important factor in encouraging innovation.

V.   Personality of individuals do influence the roles assigned to people like lead, project supervisor and manager. Motivating supervisor or Lead having grasp on five components of Emotional Intelligence (mentioned by Daniel Goleman) can

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easily instigate an EI culture where team members feel self-motivated and capable enough to deliver the optimum quality of services to the end customer.

VI. Personal emotions of an individual influence on moods and behaviors of other people greatly. Understanding of personal emotions and emotions of others at workplace is must for smooth communication. Individual's assessment for possessing these soft skills should be an important part of recruiting process. Apart from technical trainings, trainings on Emotional awareness, soft skills enhancement, and organizational ethics must also be conducted by the organization. It can actually play an essential role for software engineer to understand how to handle themselves under stress situations at work place.

VII. Analysis of gathered data also shows that the EI level of fresh graduates and/or persons having 6-8 years is better than those with experiences around 11-17 years. It is visible from the data that since emotional intelligence is much emphasized in education industry since past couple of years in management and customer oriented courses, cause of this graduates having industrial experience of 4-5 yrs are aware of this buzz word and its substance. Professionals having industry experience of more than 7 years doesn't show relatively better EI because they might not have encountered EI during their schools when psychology never crossed ways with industry.

VIII. Almost two third of respondents endorsed author's research hypothesis. Figurers are mentioned here.

o Higher the level of Emotional awareness at organizational level greater will be the performance.

Yes	No	To Some Extent
45%	8%	47%
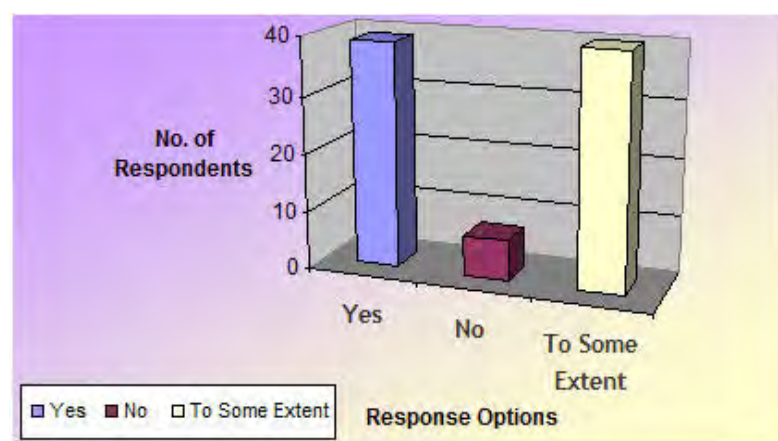
Figure 1 Respondent results over Hypothesis 1

o Increased Emotional awareness correlates with high financial gains through Customer Satisfaction.

Yes	No	To Some Extent
42%	10%	48%
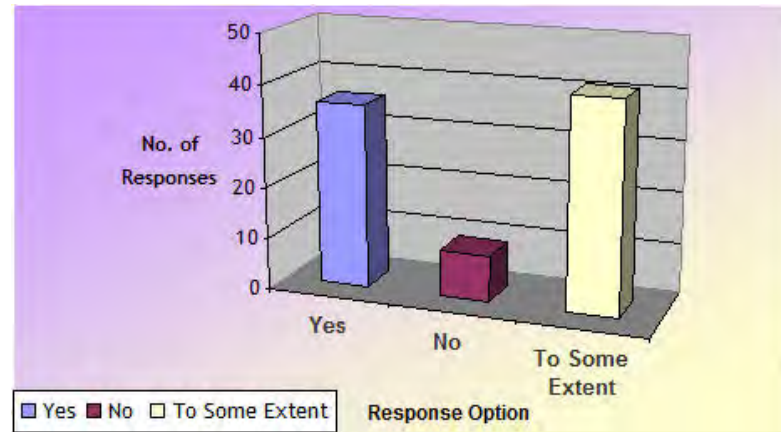
Figure 2 Respondent results over Hypothesis 2

o Emotionally intelligent culture results in employee satisfaction which results in better Quality of Service.

Yes	No	To Some Extent
52%	6%	42%
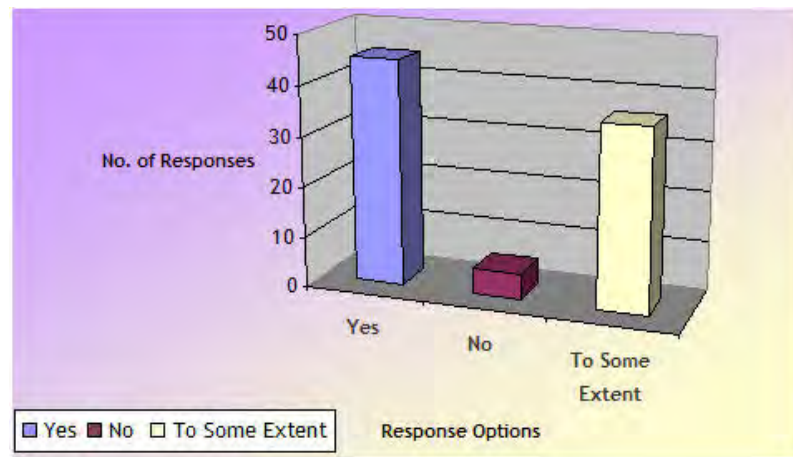
Figure 3 Respondent results over Hypothesis 3

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EMOTIONAL INTELLIGENCE CORRELATION WITH QUALITY OF SERVICE FOR ALL ORGANIZATIONS

	A	B	C	D	E	F	G	H
Organization EI	69	68	67	69	66	64	62	66
Quality of Service	82	85	86	83	87	75	74	75
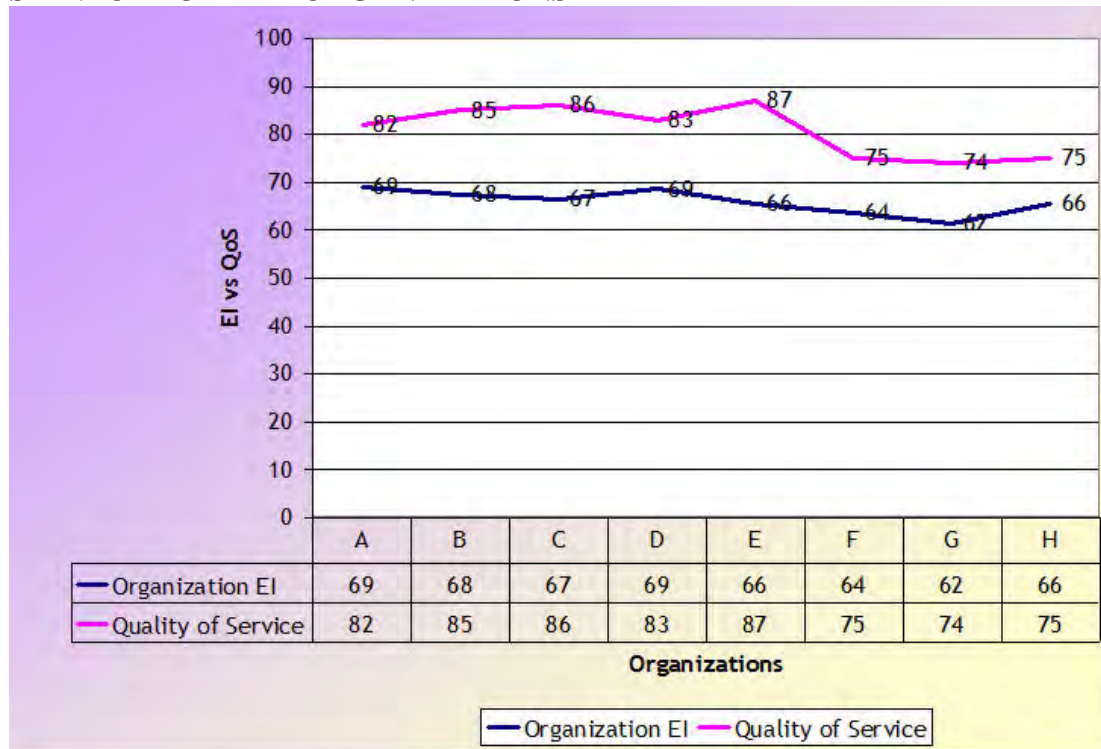
Figure 4 Graph of EI vs. QoS in all organizations.

The trend lines in the above figure representing Organization's EI and QoS show that EI of the organization positively correlates with QoS level provided by the organization. Only one deviation can be seen in the graph which was sorted out for its behavior in detail. It has been found that the Organization E is working in a domain that has only one business competitor; due to the development in the state of the art technology they attract professionals. So even with normal EI level of the organization it provides relatively better QoS.

CONCLUSIONS

Through this research study it is visible that emotional intelligence is only unknown in terms of EI buzz word, but workforce is aware of its application in one way or the other. Managers mix it up with 'common sense' and think that it can be achieved through experience within the industry. While a good number of respondents actually understand its importance and practice its implementation. It has also been observed that being emotionally intelligent is not good enough until and unless individuals are able to learn and develop emotional competencies as well. The research actively reveals the fact that employee satisfaction majorly contributes to improvement of QoS.

In software industry of Pakistan EI and soft skill trainings are not included in the organizational development programs, since top management is more interested in investing for the monetary gains in terms of ROI. Major targets are short term goals instead of long term strategic planning towards continuous quality improvement. So at

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workplace usually EI competencies are neglected area to be worked upon, people who learn it; do so for their own individual development. If EI trainings are actively instigated and endorsed by top management, they will introduce notion like self directed jelled teams which are self motivated and produce quality outcomes. All of this will result in achievement of better quality of service.

There is no doubt that only those organizations will outshine others in the future who not only understand the gravity of this matter but also nurture a culture where high EI is encouraged at the highest level.

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Integration of Affective Engineering in Product Development Processes

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Abstract

Due to globalisation and strong development of emerging markets today's buyers have the choice of an almost infinite number of similar products with comparable performance and function. Products in these markets must be innovative and at the same time recognizable by the customer. Most manufacturers therefore use customer research instruments for integration of affective values in products. However, in many companies this process is unstructured and unorganised. This brings a couple of risks in lauching these products. In this paper an integrated approach is presented for objective-subjective co-design. A model will be presented how technical and emotional attributes interact with each other. Moreover, opportunities will be presented how affective method can be integrated in common product development processes in European industry.
Also examples will be given for successful products in these sector.

Introduction

Due to globalisation and strong development of emerging markets today's buyers have the choice of an almost infinite number of similar products with comparable performance and function. In order to be successful in these markets manufacturers must ensure that their brand(s) and products are recognizable by the customers. At the same time products have to be innovative and attractive to the customer. Weighing these two points against each other is crucial since products with a lack of innovativeness as well as products with too many new features are likely to fail.

Most manufacturers therefore use customer research instruments in order to find out what features to include in new product generation and how the potential customer group feels about those alterations. The purpose is to value add the products and make them worth of its price to the customer.

Adding value to products can in principle be done in different ways. One possibility is to add physical value e.g. enhanced functionality, new features etc. to the product, i.e adding objective attributes. This is a reliable method to attract customer attention. On the other hand it makes the product more complex and expensive. Another possibility is to add affective attributes to the product. This can be done by a more modern design, using novel technical solutions and orient the product towards up-to-date lifestyle. Such a product hitting the market on the right time can be tremendously successful. However, there is a certain risk involved, since not many methods are in existence which can cope with affective customer needs. In this paper an integrated approach is presented for objective-subjective co-design.

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Figure 1: Example of Products with physical an affective value adding (source: Electrolux)

Product development methods usually can cope with adding physical value in a structured way, however, adding affective value is often based on subjective intuition of a few specialists in the company. This can work, but not involving everybody in the product development team can lead to reduced consensus about the affective value of the product. Moreover, in case the product fails due to a lack of affective value it is difficult to trace back the failure and modify the product accordingly. Consequently, it is necessary to introduce methods able to cope with affective values and introduce those methods into existing product development processes.

Aim

The aim of this paper is to present methods which can handle integration of affective values in new products and suggest possibilities how to integrate affective customer needs in product development processes.

Affective Product Development

The academic approach started in different disciplines in the 1990ies. Industrial design, mechanical engineering, psychology and ergonomics are some of them. Consequently, many different names evolved. Such are: Emotional engineering/design, Design for pleasure, affective design/engineering, Kansei Engineering etc (ENGAGE, 2005). In 2004 a European network (ENGAGE) was started. One of its purposes was to gather all these approaches under one umbrella in order to form one single research area. The most common names today might be Emotional/Affective Engineering/Design and Kansei Engineering. The ENGAGE network had originally some 21 organisations from 9 countries in Europe, mainly universities, research institutes and multi-national industries.

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with a joint focus of incorporating users' emotional needs into product design. Presently The outcome was the formation of a knowledge community under the roof of the Design and Emotion Society homepage (www.designandemotion.org). More then 50 tools for affective evaluation have been collected reaching from simple data collection tools to sophisticated design strategies. Linköping university contributed with a computer software able to collect raw data and perform Kansei Engineering evaluations. All tools have in common that they aim to bridge over the gap between user design and manufacturing (Park- Dahlgaard, 2007).

Integration of Affective Methods in Product development processes

From a more general perspective each product can be seen a function f that transforms the design parameters x_d into the system characteristics y, as in f (see **Error! Reference source not found.**).
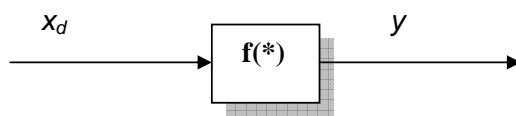
Figure 2. The product as a function that transforms design parameters into system characteristics.

One example could be a hydraulic braking system. The design parameters such as piston size, line parameters, etc. are be chosen by the product designer. Based on this choices the system produces a certain response such as braking force, pedal force, time delay, etc. The designers task is to chose the design parameters in a way that they comply as good as possible to target values stipulated in a product specification document. This is usually an iterative process requirering experience and professional skill.

However, the system response has only to meet both functional demands but also and affective customer demands. In case of the hydraulic braking system functional demands could be stopping distance of the vehicle. One affective demand of the driver could be good control of the breaking force and the impression of safety. Hence, the system characteristics can be divided into traditional technical characteristics and subjective affective charateristics (see **Error! Reference source not found.**).

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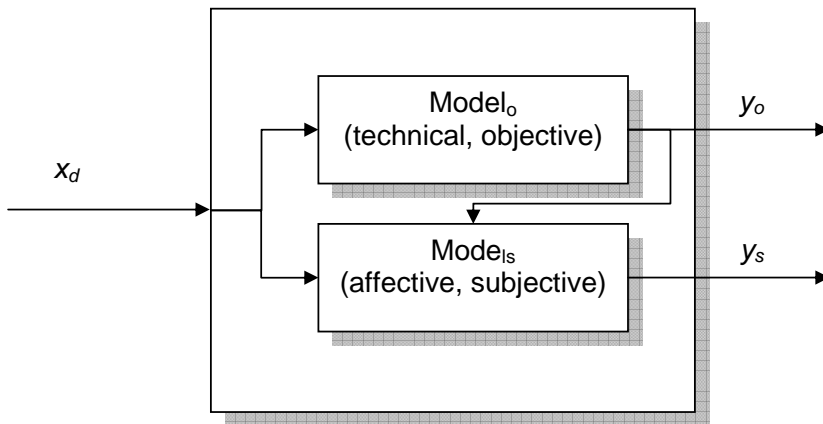
Figure 3. The model decomposed into a objective and a subjective part.

The figure above shows how the function presented in **Error! Reference source not found.** can be decomposed into a technical model and an affective model. Both parts together fulfil the target. Also the technical attributes of the product have a certain impact on the affective attributes. For the breaking system this means that choosing an actuator piston with a wider diameter (design characteristic) will decrease the breaking force (system characteristic). This does not only change the technical model of the system but also the affective model since the resulting higher break paddle force is experienced as less safe and providing less control.

Identification of Affective Model

The area of integrating affective values in artifacts is not new at all. Already in the 14th century philosophers such as Baumgarten and Kant established the area of aesthetics. In addition to pure practical values, artifacts always also had an affective component (Baumgarten, 1961; Kant, 2004). One example is jewellery found in excavations from the stone ages. Also the period of renaissance is a good example of that.
In the middle of the 19th century, the idea of aesthetics was deployed in scientific contexts. Charles E Osgood developed his Semantic Differentials Method in which he quantified the peoples' perceptions of artifacts (Osgood et al., 1957). Some years later, in 1960, Professors Shigeru Mizuno and Yoji Akao developed an engineering approach in order to connect peoples' needs to product properties. This method was called Quality Function Deployment (QFD) (Akao, 1990). Another method, the Kano model was developed in the field of quality in the early 1980s by Professor Noriaki Kano, of Tokyo University. Kano's model is used to establish the importance of individual product features for the customer's satisfaction and hence it creates the optimal requirement for process oriented product development activities (Kano et al., 1984). A pure marketing technique is Conjoint Analysis. Conjoint analysis estimates the relative importance of a product's attributes by analyzing the consumer's overall judgment of a product or service (Green and Rao, 1971). A more artistic method is called Semantic description of environments (Swedish: Semantisk Miljöbeskrivning, SMB). It is mainly a tool for examining how a single person or a group of persons experience a certain (architectural) environment (Küller, 1975).

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Although all of these methods are concerned with subjective impact, none of them can translate this impact to design parameters sufficiently. This can, however, be accomplished by Kansei Engineering. Kansei Engineering (KE) has been used as a tool for affective engineering. It was developed by Professor Mitsuo Nagamachi in the early 70ies in Japan and is now widely spread among Japanese companies. In the middle of the 90ies, the method spread to the United States, but cultural differences may have prevented the method to enfold its whole potential (Nagamachi, 1989).

Kansei Engineering

The expression Kansei has its origins in the Japanese language. It was used when Kant's work was translated from German into Japanese and it means roughly "sensitivity/sensibility". When in the 1970ies research was conducted in Japan on integration of affective values in products, this research was mainly referred to as "Emotional Engineering" (compare: e.g. (Nagamachi, 1989). In the 1980ies the method spread rapidly in the Japanese car industry and in 1986 the president of Mazda called the technique used "Kansei Engineering" (Nagasawa, 2002). Under this term the methodology spread to Western industry.

In Europe, there had been some development in this area too. However, there is a major difference how Kansei Engineering is used in European context. In Japan integration of affective values is a product development philosophy. Often it is a top-down process where the intended affective impression is a center part of the design requirements (Nagasawa, 2002). In Europe companies often apply bottom- up processes in order to achieve the "right" impression. In this way Kansei Engineering is used as one tool out of a number of different other tools. This makes it possible to easier integrate it in already existing European product development processes (Schütte, 2007).

Figure 4 shows how Kansei Engineering works in principle.
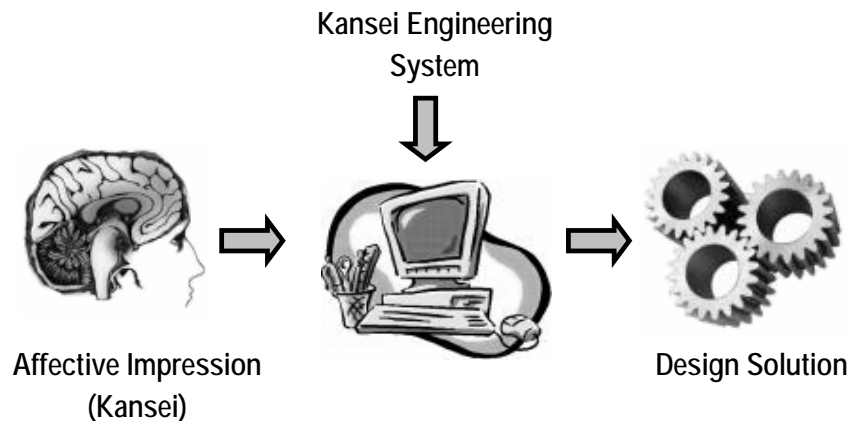
Figure 4: Kansei Engineering System (KES) adapted from (Nagamachi, 1995).

Kansei Engineering can collect the affective information of a tangible of intangible product. It then uses mathematical statistical methods in order to identify design solutions which correspond to the intended affective value. In Japanese publications, different types of Kansei Engineering are identified and applied in various contexts. Schütte

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(2005) examined different types of Kansei Engineering and developed a general model covering the contents of Kansei Engineering. This model is presented in Figure 5, below.
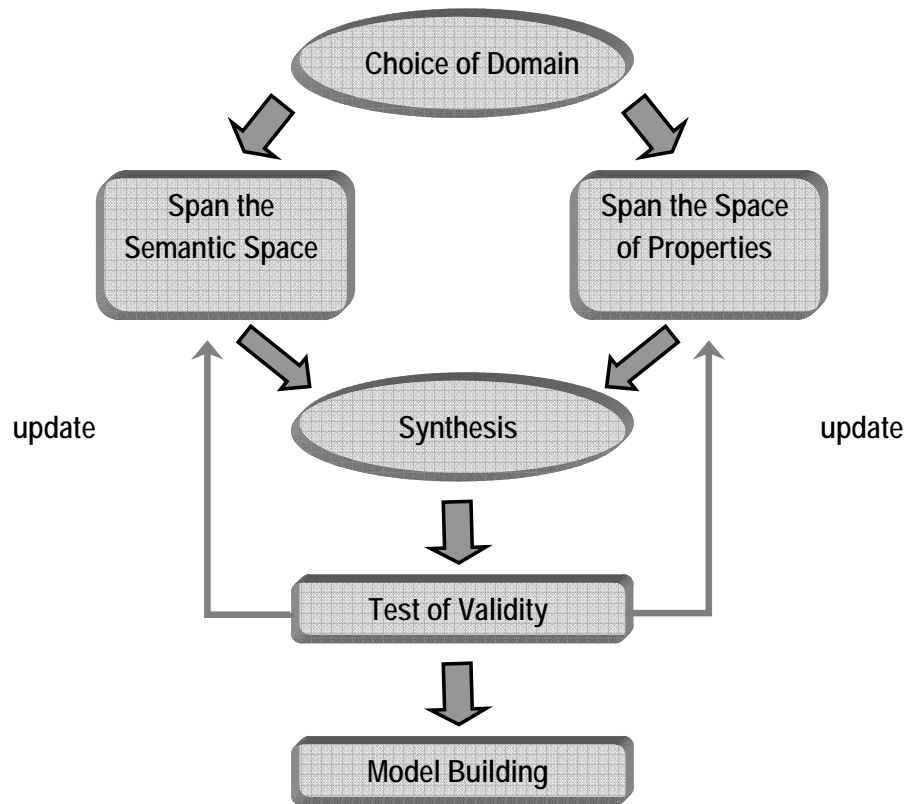
Figure 5; A general model on Kansei Engineering (Schütte, 2005).

Based on a chosen domain the idea behind the product can be described from two different perspectives: The semantic description (Osgood et al., 1957); and the description of product properties (Schütte, 2006). These two descriptions each span a kind of vector space. Subsequently these spaces are analysed in relation to each other in the synthesis phase indicating which of the product properties evokes which semantic impact and vice versa. After these steps have been carried out, is it possible to conduct a validity test, including several types of post-hoc analyses. The two vector spaces are updated and the synthesis step is run again if necessary. When the results from this iteration process appear satisfactory, a model (qualitative or quantitative) can be built describing how the Semantic Space and the Space of Properties are associated.

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Integration of Affective Models in Product Development Processes

Application of Affective Methods in Coopers Stage Gate model

Many companies use a Stage-Gate model. As a standard product development stage gate model Cooper (1998) can be quoted with his model portrayed in Figure 6. Within each stage an exactly defined part of the product development process is carried out and subsequent reviewed by the project steering committee. If the result is sufficient the project may pass the gate and continue, otherwise it is sent back for revision or rework. The Stage-gate process model allows an identification of point in time when Affective Engineering data has been found to be most useful for the product development process (Antoni and Schütte, 2002).

In particular the Kansei Engineering methodology has been applied on the product at different levels and at different stages in the product development process. A macro-level investigation was used on whole product concepts, whereas micro-level examinations are used for detailed studies on product parts after the concept is specified and follow-up investigations, which give feedback to the earlier stages of the process. These three types can be recognized in the stage-gate model in Figure 6.
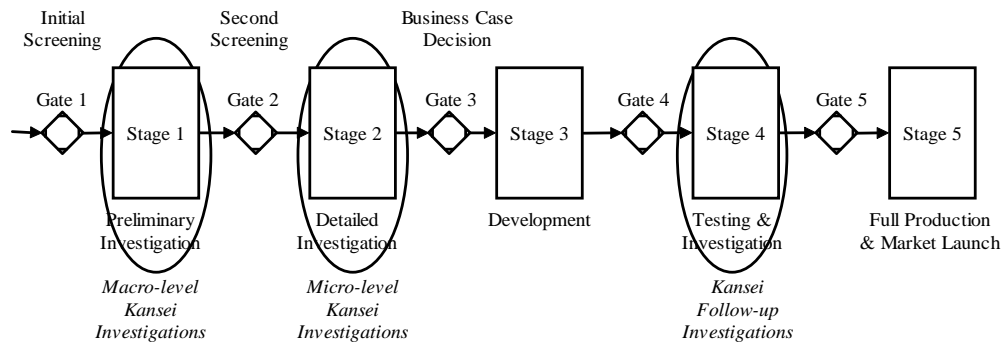
Figure 6: A Stage-Gate process for product development, adapted from (Cooper, 1998).

During the Preliminary investigation stage a quick investigation can be conducted, which will result in a large number of potential Kansei Engineering projects. This is based largely on desk research and therefore inexpensive. Kansei Engineering data from rough macro-level examinations on different competing products can be a valuable information source for the pre-selection of product concepts.

In the second stage a more detailed investigation is carried out. Typically market studies are included and Kansei Engineering can support the forthcoming decisions by focusing more carefully on selected product parts (micro-level investigations). After this point the actual development process is started. Kansei Engineering data can even support this process by making the designers aware of the Kansei their work may evoke.

In the following testing and investigation stage (follow-up investigations) Kansei Engineering is able to reveal whether the new product will fulfill the requirements regarding emotional impact or not. At this point small changes like color setting, tuning parameters or changing minor modules can still be made (Antoni and Schütte, 2002).

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Affective Data in QFD

"Quality Function Deployment" (QFD) is a common method used in product development processes. It if often performed in the early stages for concept generation. QFD uses customer demand data as an input. It than can connect the customers needs to the product properties. In this way it is possible to prioritize the product properties, make competitors comparisons and allocate production resources (Cohen, 1995). The central part of QFD is often called the "House of Quality"
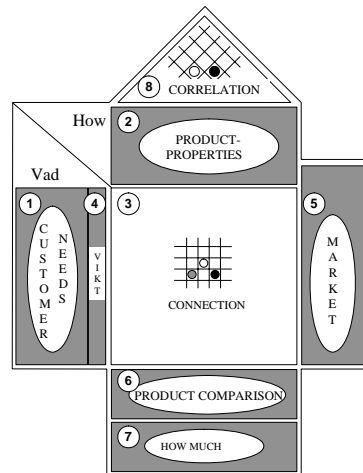
Figure 7: House of Quality.

Firstly, customer needs are identified using different types of customer surveys (field 1) and weighted according importance (field 4). Than relevant product properties are found and inserted in field 2. A group of experts than establishes the connection between both groups by setting no, weak, medium or strong connection. Using simple arithmetic the importance of each property can be calculated.

Both KE and QFD have a role in product development. By using QFD customer needs can explicitly be integrated in the product development process leading to innovative solutions. The goal is the same, whereas the input data are different. Whereas QFD input data derived from objective customer needs such as ergonomics, functionality, durability etc., Affective data is more abstract. However, it has been shown that combination of QFD and Kansei Engineering is possible. The "backward" Kansei Engineering, a special type of KE can provide a feedback loop, evaluating if the generated concept is acceptable or not (Kammerlind and Schütte, 2001). Also Kansei Engineering output data can be fed it into the house of quality as customer needs can reduce required resources (Kammerlind and Schütte, 2001).

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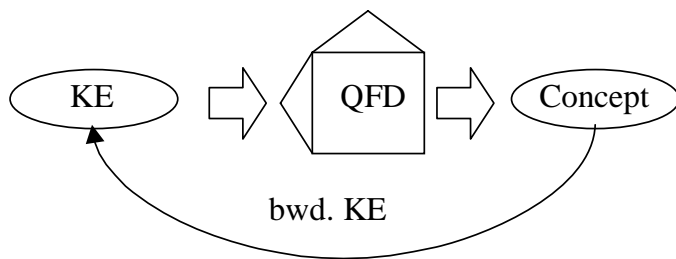
Figure 8; A combination of Kansei Engineering and QFD.

Discussion and Conclusions

Most consumer products are competing in difficult markets. Users demands are steadily increasing. One of the more recent customer demands are affective values as an ingegral part of the products. However, the integration of those affective values in product design processes is often unorganized and spontaneous and reduced to artistic design. Many engineering designers do in fact care more about functionality then affective value
The different groups within the product design group often use jargon and technical terms differently due to their different educational background. Even if they think they understand each other this is not always the case. Many engineers prefer to communicate using diagrams, and figures, managers emphasise the human organisational side of product development, marketers focus on sales and customer demands. Hence it is necessary to use methods which can grasp and document affective values of products and communicate it to all different groups.
Companies can win from integration of affective methods in product design. An organized approach can enhance communication by reduction or elimination of confusion and thereby shorten development times and consequently costs. Moreover, it can significantly help to avoid unsuccessful products and reduce the risk of failure for new products based on novel technology.. Improved communication and documentation of the affective features in products will also shift work forces' attention more towards customer focus
Although Affective Engineering and customer focus is an integrative part in product development these methods are in Europe only a supplement in product design. Concrete steps to be taken for successful integration of Affective Engineering methods are presumably based on already existing procedures in companies. As shown, these methods can be closely connected to already existing process parts such as QFD, Conjoint Analysis etc. Also, using these methods in the right stages of product is crucial for the success of the product. Affective Engineering methods are proven to be most effective if they are used in the early stages of product development. Also verifying studies just after product launch can give useful information for follow-up and new concept generation.

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Studies on Consistency Threshold of *Kansei* in Paired Comparison

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Keywords: *Kanse*i, Paired comparison, AHP, Consistency Index

Research paper

Abstract: Human *Kansei* is very complicated and it is not easy to evaluate it. Methods of paired comparison might be useful for evaluating human *Kansei* because it is generally said that human *Kansei* is nonlinear while methods of paired comparison are considered to be able to deal with nonlinear problems. In paired comparison it is important to confirm consistency of answers of each subject because if a subject's answers are inconsistent, it could not be said that evaluation of the subject's *Kansei* is validity. There are many methods of paired comparison which have been proposed and AHP (Analytic Hierarchy Process), which was proposed by Tomas Saaty as a method to help us determine priority of alternatives to select, uses paired comparison for obtaining weights to criteria and values for evaluation of alternatives with respect to criteria. In AHP consistency of a subjects' answers is judged using Consistency Index referred to as *C.I.* in short. with respect to criteria. In AHP consistency of a subjects' answers is judged using Consistency Index referred to as *C.I.* in short. Threshold of *C.I.* on consistency of subjects' answers is generally 0.1 or 0.15 by empirical judgment but there is no theoretical or experimental ground about it. Other than *C.I.* coefficient of consistency is used for judgment on consistency of a subject's answers in paired comparison. Values of coefficient of consistency are calculated from the number of circular triad which implies inconsistency of a subject's answers. Here it is studied how to determine proper threshold of *C.I.* for judgment on consistency of a subject's answers in paired comparison.

1. Introduction

Analytic Hierarchy Process (AHP) is considered to be effective method for evaluating human *Kansei* because it is said that *Kansei* are nonlinear and also has hierarchical structure while the essences of AHP are to make hierarchical structure of the problem dealing with clear setting criteria and alternatives and determine the priority of alternatives using paired comparison. Paired comparison in AHP do not only evaluates human *Kansei* but also judges consistency of the answers of each subject by Consistency Index (*C.I.*). It might be necessary to determine proper threshold of *C.I.* for judgment on consistency of a subjects' answers in paired comparison and hence it is considered to find the proper threshold of *C.I.* perceiving existence of circular triad.

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2. Methods to judge consistency

As examples of methods to make judgment on consistency of a subject's answers in paired comparison, coefficient of consistency and Consistency Index (*C.I.*) can be cited. Coefficient of consistency and *C.I.* are obtained based upon the number of circular triad and paired comparison matrix respectively.

3. Coefficient of consistence

Suppose there are three stimuli A, B, C and
A → B implies B is better than A in comparison of A and B. Then the case 1 of Fig.1 determine the order such that 1st → C, 2nd → B, 3rd → A but the case 2 of Figure 1 does not determine the order. The case 2 is called circular triad.

Case 1   Case 2
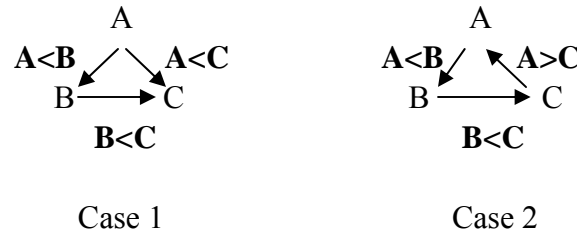
Figure 1 Circular Triad

Now letting d be the number of circular triad, d is given by

$$d = \frac{1}{6}k(k-1)(k-2) - \frac{1}{2}\sum_{i=1}^{k} a_i(a_i - 1) \tag{1}$$

where k is the number of stimuli and a_i is the number of arrows which go toward outside from each vertex. Letting ζ be coefficient of consistency, ζ is given as follows.
(I) If the number of stimuli k is odd number, we have

$$\zeta = 1 - \frac{24d}{k^3 - 4k}. \tag{2}$$

(II) If the number of stimuli k is even
number, we have

$$\zeta = 1 - \frac{24d}{k^3 - k}. \tag{3}$$

For $k \geq 8$, statistical test can be conducted as follows. First, letting f be degrees of freedom, test statistic

$$\lambda_0{}^2 = \frac{8}{k-4}\left[\frac{k(k-1)(k-2)}{24} - d + \frac{1}{2}\right] + f \tag{4}$$

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is calculated and letting α and $\lambda(f,\alpha)$ be level of significance and critical value respectively if

$$\lambda_0^2 \geq \lambda(f,\alpha) \tag{5}$$

is satisfied, It is statistically judged that answers of a subject in paired comparison are consistent.

4. Consistency index

In the questionnaire of paired comparison in AHP, subjects choose answers from nine choices and for each choice a value of evaluation are given in comparison of stimuli A and B as shown in Table I .

Table I : Values for answers in paired comparison of AHP

Choices for answers	A	B
A is extremely important than B.	9	1/9
A is very strongly important than B.	7	1/7
A is strongly important than B.	5	1/5
A is moderately important than B.	3	1/3
A and B are equally Important.	1	1
B is moderately important than A.	1/3	3
B is strongly important than A.	1/5	5
B is very strongly important than A.	1/7	7
B is extremely important than A.	1/9	9

Based upon a subject's answers, in the case where there are n stimuli, paired comparison matrix is made as

$$\mathbf{M} = \begin{bmatrix} m_{11} & m_{12} & \cdots & m_{1n} \\ m_{21} & m_{22} & \cdots & m_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ m_{n1} & m_{n2} & \cdots & m_{nn} \end{bmatrix} \tag{6}$$

where

$$m_{11} = m_{22} = \cdots = m_{nn} = 1, m_{21} = 1/m_{12}, m_{31} = 1/m_{13}, \cdots, m_{n1} = 1/m_{1n}.$$

From the paired comparison matrix, human *Kansei* to each stimuli are evaluated by the eigenvalue method or the geometric mean method and also consistency of answers of each subject is able to be judged.

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In order to judge consistency of a subject's answers, Consistency Index, that is referred to as *C.I.* is used. Let $\lambda_{\max}$ be maximum eigenvalue of paired comparison matrix. Then *C.I.* is defined by

$$C.I. = \frac{\lambda_{\max} - n}{n-1} \tag{7}$$

where n is the degree of paired comparison matrix.
 Generally, if

$$C.I. \leq 0.1 \quad \text{or} \quad C.I. \leq 0.15 \tag{8}$$

is satisfied, it is empirically judged that a subject's answers are not consistent. Since this judgment is neither theoretical nor experimental, criterion for judgment on consistency of a subject's answers is examined.

5. Judgment on consistency

In order to find proper criterion for judgment on consistency of a subject's answers, the relation between existence of circular triad and values of *C.I.* in the case where the number of stimuli is three is examined.
  When the relation among three stimuli does not make circular triad, values of *C.I.* are

$$0.00 \leq C.I. \leq 0.67. \tag{9}$$

When the relation among three stimuli makes circular triad, values of *C.I.* are

$$0.67 \leq C.I. \leq 3.56. \tag{10}$$

Therefore if the value of *C.I.* is less than 0.67, there does not exist circular triad.
  Now if a subject answers as shown in Figure 2, the order among three stimuli A, B, C is determined such that A is first, B is second, C is third and $C.I. = 0.67$ which is the largest in the case where there does not exist circular triad.
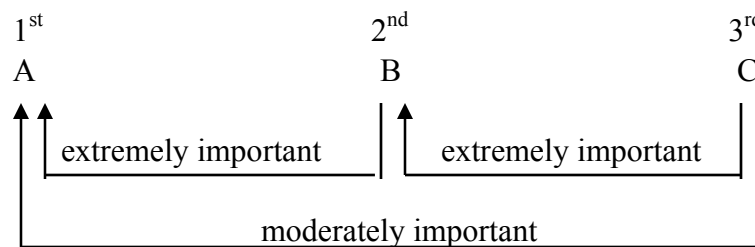
Figure 2: Examples of answers for the maximum of *C.I.*

Table Ⅱ shows the largest values of *C.I.* in the case where there does not exist circular triad when the numbers of stimuli are 3, 4, 5, 6, 7, 8 and 9,

Table Ⅱ : Maximum value of *C.I.* to the number of stimuli

The number of stimuli	Maximum value of *C.I.*
3	0.67
4	0.77
5	0.82
6	0.84
7	0.85
8	0.87
9	0.88

Let x and y be the number of stimuli and the largest value of *C.I.* respectively. Then x and y fit to the quadratic regression equation

$$y = -0.01x^2 + 0.21x + 0.39 \tag{11}$$

where coefficient of determination is 0.995 , and also fit to logarithmic regression equation

$$y = 0.41\log x + 0.50 \tag{12}$$

where coefficient of determination is 0.919 . In Table Ⅲ estimate by (11) and (12) is shown when the numbers of stimuli are 3, 4, 5, 6, 7, 8 and 9.

For another example of answers if a subject answers as shown in Figure 3, the order among three stimuli A, B, C is also determined such that A is first, B is second, C is third and it is considered that the answers are consistent. In this case $C.I. = 0.28$ and this value is considered to be the threshold of *C.I.* on consistency of a subject's answers in paired comparison.

Table Ⅲ: Estimate for maximum value of *C.I.*

The number of stimuli	Estimate (11)	Estimate(12)
3	0.69	0.70
4	0.75	0.75
5	0.80	0.79
6	0.84	0.83
7	0.85	0.85
8	0.87	0.88
9	0.88	0.90

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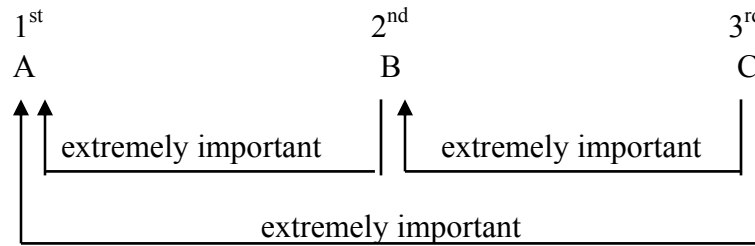
Figure 3: Examples of answers for the maximum of *C.I.*

Table IV shows the values of *C.I.* in such the case of Fig.3 when the numbers of stimuli are 3, 4, 5, 6, 7, 8 and 9.

Table IV: Threshold of *C.I.* to the number of stimuli

The number of stimuli	Threshold of *C.I.*
3	0.28
4	0.44
5	0.55
6	0.62
7	0.68
8	0.72
9	0.75

Let x and y be the number of stimuli and the largest value of *C.I.* respectively. Then x and y fit to the quadratic regression equation

$$y = -0.01x^2 + 0.22x - 0.26 \tag{13}$$

where coefficient of determination is 0.998, and also fit to the logarithmic regression equation

$$y = 0.98\log x - 0.16 \tag{14}$$

where coefficient of determination is 0.992. In Table V estimate by (13) and (14) is shown when the numbers of stimuli are 3, 4, 5, 6, 7, 8 and 9.

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Table Ⅴ: Estimate for threshold of *C.I.*

The number of stimuli	Estimate (13)	Estimate(14)
3	0.28	0.31
4	0.44	0.43
5	0.55	0.53
6	0.62	0.60
7	0.68	0.67
8	0.72	0.73
9	0.75	0.78

For the above, it is seen that the largest value of *C.I.* in the case where there does not exist circular triad and the threshold of *C.I.* on consistency are able to be estimated by regression equations.

6. Concluding remarks

Consistency of human *Kansei* in paired comparison was considered taking Consistency Index (*C.I.*) in AHP as the example to express consistency. It might be able to be said that threshold of *C.I.* on consistency of human feelings vary with the number of stimuli and it can be estimated by regression equation.

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A Model for Profound Affection and Attractive Quality Creation

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Abstract

Purpose: The purpose of the paper is to present and discuss the concept of Profound Affection. The paper presents a framework (a model) for understanding why products and Services may have a profound affection on customers/ users and to discuss shortly how this framework may be applied when developing new attractive products/services or when existing products/services are assessed for their attractiveness.

Methodology/Approach: The research methodology is a combination of desk research (literature analysis), reflections and model building.

Findings: The authors suggest a structural model as a possible expanded framework for future Kansei/ Affective Engineering research studies. According to the model *profound affection* is a result of the following six enabling factors: 1. Sensing Experience, 2: Emotional Experiences (Kansei), 3. Behavioural Experiences/ action, 4. Social Experiences/ Interactions & Relations, 5. Spiritual Experiences/ Moral, Ethics, 6: Intellectual Experiences/ Cognition.

Originality/Value: The author defines "Profound Affection" as a comprehensive state, which is a result of a combination and interaction of sensing, intellectual/cognitive, emotional, social, behavioural and spiritual experiences. "Profound Affection" is not only a result of *sensing or emotional experiences.*

Keywords: Kansei**,** Affective Engineering Design**,** product development**,** profound affection**,** experiences, attractive quality creation

Category: Research paper

1 Introduction

Creating desire to get something *for example* getting a new attractive expensive product as a Louis Vuiton bag, requires *Profound Affection*, which is a very comprehensive state resulting from a combination of intellectual/ cognitive, emotional, social, behavioural and spiritual experiences.

Kansei Engineering, which is a relatively new research field, contains a promising methodology for designing and creating new attractive products and services with a *Profound Affection* on the users. The Kansei Engineering methodology, which has its roots in Japan from beginning of the 1970's, aims to design and develop products/ services that match customers' emotional, psychological feelings and needs.

It is the aim of this paper to suggest a new framework in the form of a structural model, which can be used systematically in understanding the potential enablers of Profound Affection which may be used for creating new innovative and attractive products (= *Attractive Quality Creation*).

Section 2, with the subtitle "From Human Needs to Profound Affection", illustrates the background for this. The section starts with a discussion on the different dimensions of human needs and ends up with a discussion of products where one product did not compete well

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while other products attracted customers surprisingly well even if the price levels were unbelievable high.

In section 3 the suggested framework (model) for understanding the potential enablers of Profound Affection is discussed. The application of the model will shortly be discussed in Section 4. The article terminates in section 5 with a summary and a final discussion on the future implications of the suggested model for understanding Profound Affection

2. From Human Needs to Profound Affection

From many fronts we receive clear signals that people today care more and more about whether products and services match and appeal to their feelings, emotions, personal life styles, identities, and even moral/ ethical preferences. The most attractive products/ services of tomorrow will in our view be designed to satisfy all dimensions of human needs – manifest as well as latent needs. To be successful companies have to attain a profound understanding on the complexity of human's different needs and the power of satisfying these needs.

To understand the different dimensions of human needs Dahlgaard-Park (2003) suggested a new framework model - the "*Trinity of Human Needs*" – which classifies human's needs into the following three dimensions:

1. Physical or Biological needs
2. Mental/psychological Needs (embracing emotional, intellectual, social and aesthetic needs);
3. Spiritual or Ethical needs.

By working more explicitly with the "Trinity of Human Needs" companies may be able to give clear input to understanding the weaknesses of existing products and hence to developing new products and services which match the different dimensions of human needs. Let us illustrate this core with an example.

In 1998 the authors of this article were involved in a transformation process in Pioneer Denmark (Dahlgaard & Dahlgaard-Park, 1999). The background of the transformation process was that Pioneer Electronics had competition problems on the world markets especially with the other two Japanese competitors – Sony and Matsushita Electronic Corporation (Panasonic etc.). To start a transformation process aiming at changing the image of Pioneer and its product branding the president of Pioneer gave a New Year speech to top managers from Pioneer companies all over the world. In this New Year speech he announced Pioneer Electronic Corporation's new corporate identity which at the same time was announced as the corporation's *Vision 2005*. The vision was presented with a tree metaphor picture as shown in figure 1 below.

'The key message from Pioneer's president was that all efforts from companies and employees all over the world must now be focused on the goal - *customer satisfaction is our ultimate goal*. But this ultimate goal can only be achieved if employees all over the world in their different jobs participate actively in understanding the different dimensions of customer needs and problems. Having understood the variation, interdependence and depth of customer needs then people can begin to design new products which may be able to "Move the Heart and Touch the Soul". People may gradually understand that attaining such a state requires that the customers will have positive experiences related to sensing, cognition, morality, action, and social relations. All these experiences will together determine if the product will "move the heart and touch the soul".

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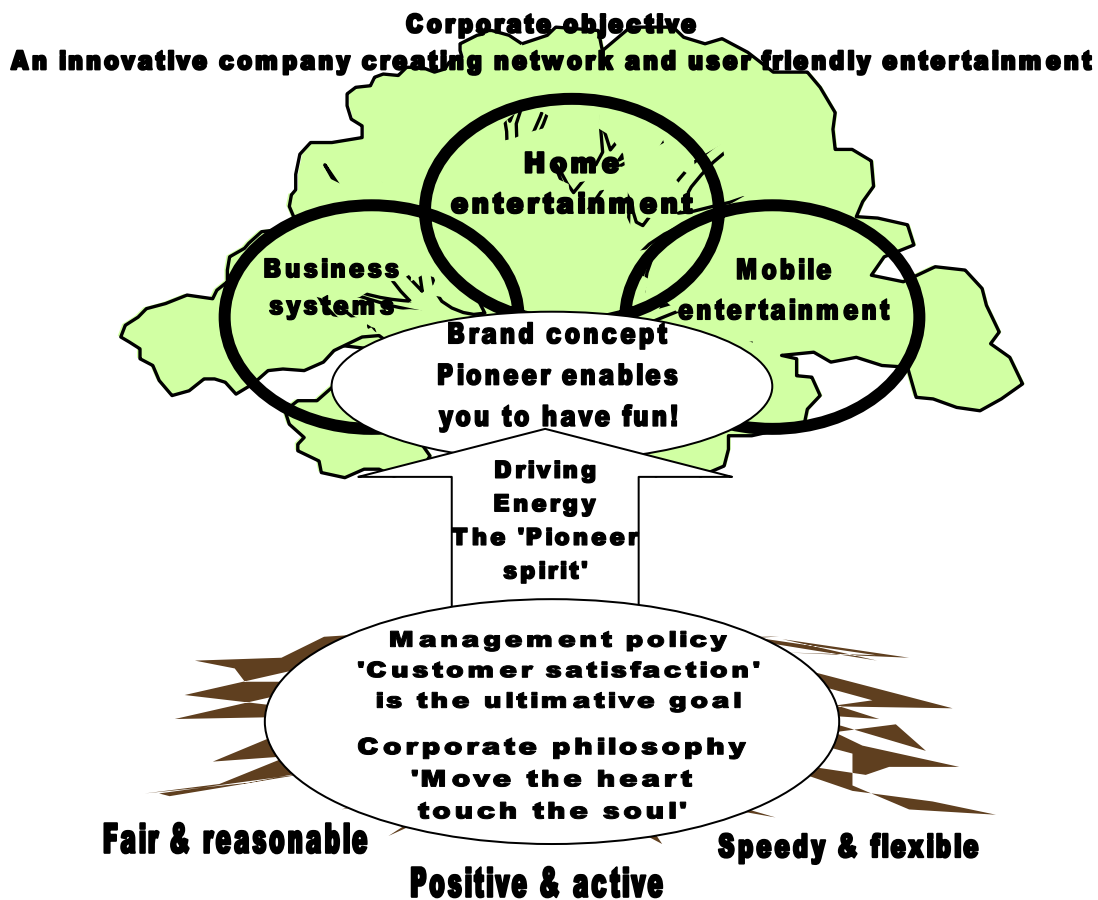
Figure 1: Pioneer Electronic Corporation's New Corporate Identity (Vision2005)

3. A Model to understand Profound Affection

Inspired by a model proposed by B. H. Schmitt (1999), used in Nagasawa (2008), to create and understand customer experiences, we will in this section suggest a model to understand Profound Affection. Schmitt's model (1999) consists of the 5 factors *Sense, Feel, Think, Act* and *Relate*.

The suggested model came up as a result of critical analyses and discussions based on our own research and observations from the First European Conference on Kansei/ Affective Engineering, our previous discussions and reflections on the Pioneer metaphor above and by combining with research on human needs (especially the suggested Trinity Model for Human Needs). The resulting model is a structural model which we regard as a possible expanded framework for future Kansei/ Affective Engineering research studies (see Figure 2 below).

As can be seen in the model profound affection is a result of 6 enabler factors.

X1: Sensing Experience/ the 5 Senses

Sensing experiences are often in Kansei Engineering related with emotions, but seen from a product development viewpoint it makes sense to regard it as an independent factor which also may be related to other factors of the model in figure 2. Simple questions to ask could be: Is the product nice to see, nice to hear, nice to touch, nice to smell, or nice to taste?

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X2: Emotional Experiences (Kansei)

Emotional experience is a result of sensing experiences and is more comprehensive than each individual sensing experience. A simple question to ask is: What kind of emotions will the product "bring" to the users? Happiness, joy, gloominess, sadness, loneliness, …?

X3: Behavioural Experiences/ Action

These experiences reflect user behaviours when interacting with products and services. Questions to ask: Is the product user friendly? Is the product comfortable? Do users feel unity with the product or alienation?

X4: Social Experiences/ Interactions & Relations

Products are here regarded as instruments for building social interaction & relations. Question to ask: Is the product strengthening your social relationships and interactions? Product examples: Mobile telephone, MP3, internet, blocs, etc.

X5: Spiritual Experiences/ Moral, Ethics

Customers of today are now concerned more on spiritual experience including moral and ethics of producing, using and scrapping the products. Questions to ask: Is the product/service produced ethically correct? Is the product dangerous or polluting the environment? How are the products contributing to global warming, etc?

X6: Intellectual Experiences/ Cognition

These experiences are related to traditional quality attributes belonging to the basic/ must-be quality dimension. Questions to ask: What and how are the functions of the product? Are they functioning logically? Is the product reliable, safe, etc.?
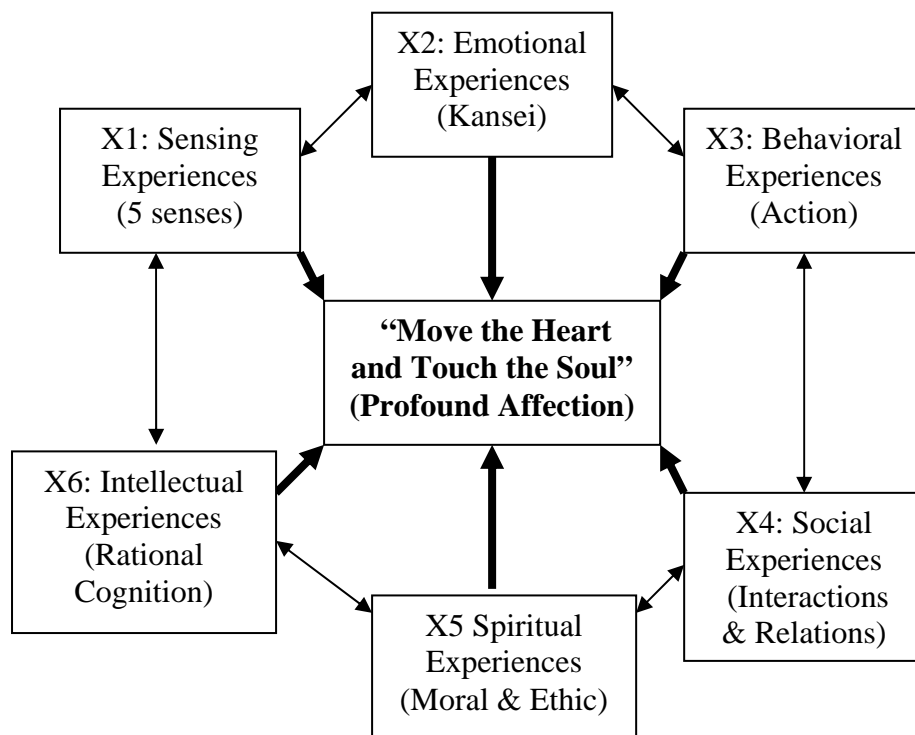
Figure 2: A Structural Model for Understanding and Building "Profound Affection"

As the model shows "Profound Affection", where customers' hearts are moved and their souls are touched, is a very comprehensive state, which is a result of a combination and interaction of sensing, intellectual/cognitive, emotional, social, behavioural and spiritual experiences. "Profound Affection" is not only a result of *sensing or emotional experiences.*

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Building Profound Affection depends on the context. For some products or services all one-factor contributions may be important enablers as well contributions from several of the potential interaction effects, while for other products maybe only a limited number of one-factor contributions may be relevant. In the following all possible contributions to building Profound Affection are specified.

Profound Affection =

X1+X2+X3+X4+X5+X6	(one factor contributions)
+ XiXj+ …..	(two factor interactions)
+ XiXjXk+ …..	(three factor interactions)
+ XiXjXkXl + …..	(four factor interactions)
+ XiXjXkXlXm+ …..	(five factor (interactions)
+ X1X2X3X4X5X6	six factor (interactions)

Let us discuss the model by using an example from women's bags – *Louis Vuitton* luxury bags. To understand what a Louis Vuitton bag is we searched on the internet and found the following explanation.

> *Are you also looking for some real louis vuitton bags for yourself? Celebritis like Britney Spears and Jennifer Lopez carry the most popular of the handbags - louis vuitton bags. The French designer has created a huge line of purses, woman's louis vuitton wallet bags that are most sought after in the world and are first on every woman's wish list every Christmas! Authentic louis vuitton bags and the louis vuitton messenger bags are really expensive but they have that elegant look to them. They have been crafted with skill and experience and are made from the finest leather. Each authentic louis vuitton bag or the louis vuitton messenger bag is unique in itself. The quality of Louis Vuitton handbags is recognized worldwide and they are so popular that the louis vuitton replica bags and the cheap louis vuitton bags are just as prized from those who can't afford the real thing. Real Louis Vuitton bags and purses can never be duplicated exactly even by the counterfeiters and therefore still carry a hefty price tag.*

Just coming back from a 6 weeks stay in Japan we are still surprised of having seen how many women in all ages that are daily walking around with a *Louis Vuitton* bag. In fact, 30% of Louis Vuitton's sales are coming from Japan!

We could not understand why so many women had been affected by this brand and also how they could afford it. In our part of the world it is very rare that you see young women walking along with such a luxury bag. To understand better we interviewed one of the young owners, a young lady between 25 and 30 years old. Her explanation to the question "*why do Japanese girls want to have LV bags and other famous brands and how can they afford?*" follows here:

> *One big reason is that we all want to have something same with others. Japanese like to do the same thing that someone else does. We are lacking individuality, and feel safe when we do the same things as others do. And we think that it's really cool to have things that are famous brands. We have so much hanker for western culture. We, Japanese, have so many complexes within us as Asians. We like to be like western people. That's why we are buying products of western famous brands.*
> **Why we can spend so much money in brands things?**

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Recently, young people tended not to spent money on cars and other similar expensive products. Because we spent money in those brands like LV bags, we can't afford to buy cars and owing homes.

This is only one interview which alone cannot be a good example for illustrating all factors of the model in figure 2. We can only guess about what are the most important factors behind the deep desires of Japanese women buying Louis Vuitton luxury bags and other famous luxury bags. More interviews are needed for explaining the importance of the model. From our own observations and discussions with other Japanese users of Louis Vuitton luxury bags we came up with our understanding as seen in the following.

X1: Sensing Experience/ the 5 Senses

Louis Vuitton bags are leading the avant-garde of fashion without compromising traditional craftsmanship of luxury leather goods. The Louis Vuitton handbags were not the first line of products manufactured by Vuitton when he opened his luggage store in France during the mid-1800s. In fact, it wasn't until about 1900 that his company began selling purses. However, all of the company's products, at least for the past 100 years, have displayed the same type of "signature" or "monogram" on their fabric, which makes Louis Vuitton items very recognizable. Japanese Women like others feel good and attracted by the nice design and quality of the bags. The design is attractive to look at and touching the bags support the first impression. The inner design of the bag is also smart and attractive. Some of the bags – the Louis Vuitton multicolour bags – have been designed by a Japanese designer – Takashi Murakari.

X2: Emotional Experiences (Kansei)

Japanese women feel proud when walking around with these very recognizable and smart bags. We think that the special design by Takashi Murakari also bring joy to the user.

X3: Behavioural Experiences/ Action

As said above the design of the bags are user friendly, and combined with the other feelings described above the users experience a form of unity with the bag while using it.

X4: Social Experiences/ Interactions & Relations

The interview with the Japanese woman tell us that the LV bags are regarded as strong instruments for building social interaction & relations. The Japanese do not want to be "outside" the club – meaning that "*Japanese like to do the same thing that someone else does. We are lacking individuality, and feel safe when we do the same things as others do*". It seems clear for us that to own a Louis Vuitton bag is a tool for strengthening social relationships and interactions?

X5: Spiritual Experiences/ Moral, Ethics

We don't know what kind of spiritual experiences are related to Louis Vuitton Bags by the Japanese women, but it seems quite clear that this may be an important issue for the future.

X6: Intellectual Experiences/ Cognition

As said above the Louis Vuitton bags are well designed for practical use, and the bags are reliable. This is one reason why there is a huge second hand market in Japan with Louis Vuitton bags as well as other famous luxury brands. So this may be one logical reason for buying a Louis Vuitton bag. The experience in Japan is that it is easy to sell it at a relatively high price after having used the bag for some years and then you may be interested in buying a new model. The same as selling the used car when you wish to buy the new model.

We have no data from interviews or else to support hypotheses about potential interaction effects of the different forms of experiences. A research project is now in the process to be

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started up to estimate such kind of effects from different kind of luxury or high prized products.

4. Application of the Model

It is our belief, that the structural model in figure 2 can be used systematically in building new innovative products or services with a Profound Affection, which will attract the customers (= Attractive Quality Creation). For that purpose we believe that the model could be used as a check in every *phase* and *gate* of major product development processes from *ideation* to *market launch* and *post implementation review*.
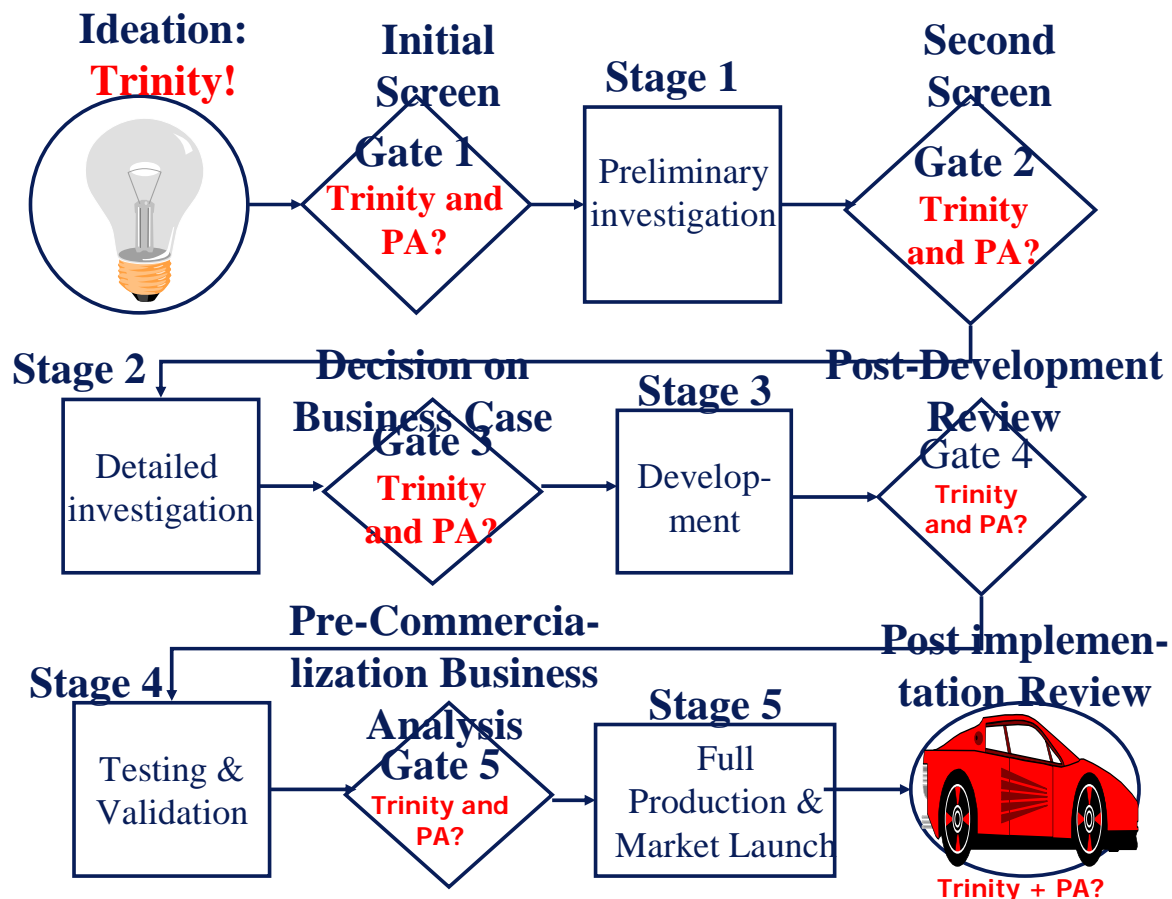
Figure 3: A Stage-Gate Process for New Product Development

By working systematically integrated into the process for new product development we are convinced that companies will improve their chances for coming up with new attractive products – products which will have a profound affection on customers' experiences. We are also convinced that this is the best and most effective ways gradually to build new effective brands.

5. Conclusion

Because the Japanese terminology Kansei gives associations of sensing and emotional aspects only and does not embrace other essential aspects such as spiritual, intellectual, social aspect etc., as shown in figure 2, we suggest adopting the terminology of *Affective Engineering Design* in stead of Kansei Engineering when the research aims at understanding the broader scope of "Profound Affection".

An observation from the QMOD2007 conference is that Kansei Engineering is widening its application areas from traditional product design to service design and other areas. When doing that it is a necessity to broaden the traditional scope of Kansei Engineering to the new scope of "Profound Affection". We therefore suggest that Kansei Engineering researchers in the future should not be too narrow in their research. Think "*New Kansei Engineering*" which we call "*Affective Engineering Design*". Go back to basics, understand human needs, and then try to understand the enablers (figure 2) for moving people's hearts and touching their souls.

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A Case on Change Management

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0. Abstract

Introduction

Entreprise is a Danish railway technical contractor with a history dating back to the first railway built in Denmark. This railway was completed in 1847 and connected Copenhagen and Roskilde.

The challenge

For many decades Entreprise has been operating as a part of DSB (the Danish state railways) and Bane Danmark (the operator of the Danish state railway network) and has not been facing any competition. However, as the railway sector across Europe is being liberalised, Entreprise is now in the process of separation from Bane Danmark, and exposed to competition from both domestic and foreign contractors. On the other hand the liberalisation of the sector also offers opportunities as Entreprise can develop new European markets. These challenges combined with an expected increase in European railway infrastructure investments put Entreprise at a crossroad – should Entreprise stay national or expand internationally?

The transformation process

In February 2007 a new management with the ambition to face the future challenges took office at the Entreprise Headquarter. A new vision for Entreprise reflecting a strong commitment to excellence has been created and approved by the board. The vision is to become the leading railway technical contractor in Scandinavia by 2010 and in Europe by 2015. A four track transformation plan to support the implementation of the vision has been generated: *Ready, Set, Go* aims at mobilising the organisation, *Better Time on the Track* focuses on processes and continuous improvements, *Technology Conquest* of technology and innovation, and *Business Development* enables Entreprise to expand into new markets. The new vision of Entreprise is reinforced internally and communicated externally through an extensive branding programme to establish a clear and appealing corporate identity.

Methodology

In this paper the transformation of Entreprise starting in February 2007 is assessed and reviewed based on data collected from interviews with the executive management team and key employees in the implementation process. Kotter's (2007) framework is used as a reference, and problems and limitations applying this framework are discussed from a practical point of view. Recommendations when applying the framework on a practical setting are made, and we hope to inspire the academic thinking concerning transformation and change processes.

Category: Case study

Keywords: *Transformation, change management, excellence, liberalisation, implementation*

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1. Key findings

Across Europe large public organisations are in the process of changing from bureaucratic organisations operating under political control to market oriented organisations operating under commercial conditions. The article argues that this kind of change calls for adjustments in the prevailing approach to implement change which is in practical situations may be based on Kotter's 8 steps to transforming an organisation. The article proposes a new content of Kotters first step and introduces a step 3 in the change "from bureaucracy to business" or "from public to private" as this type of change is sometimes labelled.

In the case of Entreprise the need for change originates from a long drawn and rather unpredictable political process which is not uncommon, neither in Denmark or to the authors' best judgement in other democratic systems across the world. When the new management initiated the change process in February 2007 there was a wide spread belief among the employees in Entreprise that changes needed to happen, but it was may be too late. So rather than building a sense of urgency, which would only have deepened the frustrations in the organisation, the **first step** of management in the case of Entreprise was to **inspire trust in the future**. The message was clear: "We can meet the challenges ahead and it is not too late (but we are in a hurry)".

Further it is argued in the article that a major challenge in the change from "bureaucracy to business" is to replace the bureaucratic management frameworks and ways of thinking with a new, common language that makes sense under the commercial conditions. If this is not done, the organisation can not articulate or understand a new vision and new strategies. Therefore, the **third step** of Entreprise's change process was to **create a new common business language.** In the case of Entreprise, the EFQM Excellence model is used as one important approach to create this new common language. The Excellence model was chosen due to the strong focus on results, customers and learning, which basically lacks in many bureaucratic organisation's vocabulary.

The transformation of Entreprise has therefore been planned in the following nine steps which the authors will recommend in the change "from bureaucracy to business":

Step 1: Inspire trust the future
Step 2: Pull together a guiding team
Step 3: Create a new common business language
Step 4: Develop the change vision and strategies
Step 5: Communicate for understanding and buy in
Step 6: Empower others to act
Step 7: Produce short-term wins
Step 8: Don't let up – produce still more change
Step 9: Create a new culture

2. About Entreprise

History

Entreprise is a Danish railway technical contractor with a history dating back to the first railway built in Denmark. This railway was completed in 1847 and connected Copenhagen and Roskilde.

For many decades Entreprise has been operating as a part of DSB (the Danish state railways) and Banedanmark (the operator of the Danish state railway network) and has not been facing any competition. However, as the railway sector across Europe is being liberalised, Entreprise

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is now in the process of separation from Bane Danmark, and exposed to competition from both national and international contractors.

A few facts

Entreprise maintains 2605 km of railway tracks in Denmark. The tracks are daily used by 2700 trains with a total of more than 38.000 departures from Danish train stations. Besides maintenance, Entreprise now has the capacity in terms of people, skills, equipment and technology to undertake any given construction project of new railway infrastructure in Scandinavia and Northern Europe.

In 2007 the total turnover was approximately 1.3 billion DKK generated by 900 employees. In 2007 and 2008 Entreprise has been able to give the best tender to all major construction projects. The projects undertaken have been successfully completed or are in satisfactory progress. Entreprise is without any comparison "Best in Denmark" in 2008.

Situation by February 2007

2006 was an "annus horribbilus" for Entreprise and marked the culmination of a period of decline. A temporary management was installed to run the daily operations – after the former management had suddenly resigned – and there was a general feeling that Entreprise had been caught in a vacuum. Among both managers and employees there was a distinct lack of belief in the future and key people was trickling out of the organisation and joining competitors.

In November 2006, the Danish parliament made a political agreement on the traffic area. New significant investments in railway infrastructure were a part of the agreement and quite important for this case it was decided that Entreprise was to be privatised. For many years this had been a subject for political discussions making Entreprise's future uncertain. As a response to the new and clearer political signals Entreprise's Internal Advisory Board started searching for a CEO capable of the challenge to revitalise Entreprise and Søren Horn Petersen took office in Entreprise 1st of February 2007.

The first impressions that met the new CEO were very similar to the picture drawn up by the internal advisory board.

- Entreprise was in a bad state after years of downsizing
- There was no trust in the future after years of uncertainty and lack of a clear vision
- People were leaving Entreprise

But at the same time the first impression of the CEO was that there are still a lot of heart left in the organisation and a true passion and devotion for constructing and maintaining railways. But Entreprise needed a clear vision for the future badly.

3. The change process in Entreprise

Creating the vision

By February 2007 the protection as of state monopoly was disappearing, but at the same time the limitations traditionally imposed on Danish state monopoly organisations were still intact, e.g. the employees' collective agreements and obligations towards Bane Danmark.

The atmosphere was characterised by resignation and an attitude that Entreprise had very limited influence over its own future. This attitude was well-founded in past experiences as explained earlier, but it was also threatening to become self-fulfilling now the outlook was brighter.

In order to revitalise Entreprise, the new management team attempted to give the organisation a "sense of influence" of it own future by raising the question: What future does Entreprise choose? By addressing this question on various manager meetings across Entreprise the new management team demonstrated the will to fight for the future of Entreprise.
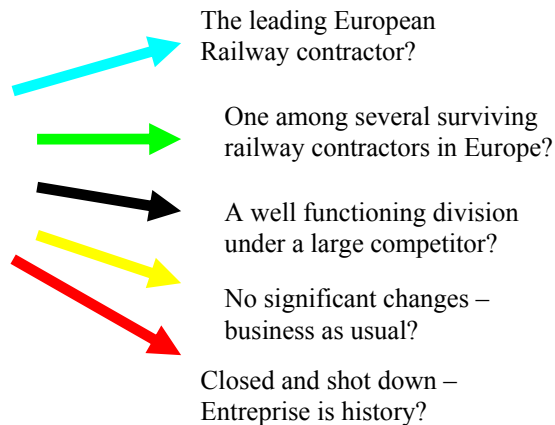
Figure 1: Entreprise at a crossroad

The question was answered by the management team with an announcement of a new vision in sharp contrast to the general atmosphere of resignation: We want to become "Best on the Track" in Scandinavia by 2010 and in Europe by 2015!

This vision reflected at the same time a significant commitment to excellence as it was elaborated that "Best on the Track" means the best leadership, the best strategy, the best processes and the best results in terms of customers, employees and finance. The response from the organisation of now having a management team clearly committed to fight for and shape the future Entreprise was instant. Energy started to build up in the organisation together with some impatience. "Best on the Track" in Europe 2015, **how** are we supposed to do that? Answers, directions and the possibility for all to participate was now the big issue and pressure for seeing some real action and results was rising.

Building management infrastructure

To build a solid framework around the change process, management infrastructure was developed and adapted to Entreprise. Three core principles were at the heart of the development process:

- The new management infrastructure should fit Entreprise and not the other way around
- The new management infrastructure should replace old terminology and management frameworks with new ways of thinking relevant under commercial conditions to support the change "from bureaucracy to business"
- To develop the simplest possible management infrastructure to keep the focus on what really matters in a change process, namely people, and not allowing this focus to be blurred by complex ICT projects or glittering management models.

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Therefore, it was not only a question about getting some ICT systems implemented but a question about developing new management processes, creating common "mental maps of the world" and building the necessary competencies in the organisation to handle the new management processes. The development process was managed as an organisational development project with continuously interaction with and involvement of key people in all four project phases: Idea, plan, action and daily operations.

As illustrated in figure 2 below the new management infrastructure is formed by four basic building blocks.

Entreprise's process map of business and support processes	Entreprise's strategic planning and control system (including project management)	Entreprise's Balanced Score Card with 21 key performance indicators
Entreprise's company model The EFQM Excellence model		
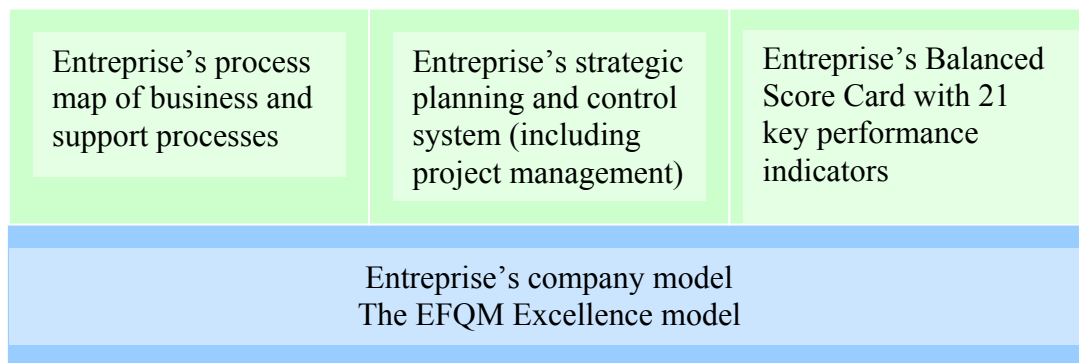
Figure 2: The new management infrastructure

The EFQM model forms the framework around the leadership and management in Entreprise and helps to shift the focus from the bureaucratic management thinking to a holistic business orientted approach to management and leadership. To enforce the implementation of the principles underlying the EFQM model and provide useful tools for management of the daily business, three blocks of management infrastructure have been developed. The Entreprise process map helps focussing on processes and continues improvements, the balanced scorecard keeps track of key performance indicators and the strategic planning and control system is laying out the path to "Best in Europe 2015" and following progress.

4. Results so far

This has been successful

When interviewing the management team it becomes clear that from their perspective the change process is on a very satisfactory track. Quotes from the interview:

"The management team has never before worked together like this – with so much focus on common goals."

"The spirit of Entreprise has completely changed since February 2007 – I can feel the change every where in the organisation".

"We now help each other across the organisation, not only in the management team but at all levels and sites".

"In 2007 people left us to join the competitors. In 2008 they have started to come back again and they are very welcome".

The hard facts are that Entreprise produced the best bottom line result ever in 2007 and managed to raise turnover by 20% with the same resources available. The conclusion on the soft side is: The fighting spirit is back in Entreprise.

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This has not been successful - yet

Confronted with the question of what has not been working well in the change process, the management team points out that too many projects were launched simultaneously in October and November 2007. The consequence was that some projects and processes were not given the necessary attention and have been shut off from the change process. Especially the focus on Entreprise's process map and a wide involvement in continuous improvements have been suffering from the peaking work loads experienced by the management team in late 2007.

Threats to the change process

The visible changes in patterns of thinking and behaviour have occurred surprisingly fast when considering the long history of Entreprise. When the management team was confronted with the question, if a change comes this fast can it disappear similar fast, the answers was basically confirmative. Both internal and external events can seriously derail the process at this stage. A major external threat is an interruption of the political process hindering Entreprise's independence. On the internal side it is clear that much depend on the present management and a change of management at this point in time can lead to a serious setback in the change process. In both events the management team foresees impact on morale and spirit in Entreprise will be devastating for the change process. The results achieved so far are still fragile and subjects to regression.

It is much too early to declare victory! To use the words of Winston Churchill: "Now this is not the end. It is not even the beginning of the end. But it is, perhaps, the end of the beginning".

5. Errors in the change process – looking back at the process using Kotter

Even though Kotter's 8 errors when transforming an organisation is common knowledge, the change process in Entreprise has not been planned or implemented based on this. It is therefore relevant to examine the change process retrospectively, looking for evidence of the errors and checking weather the 8 errors actually applies in the change "from bureaucracy to business".

Error 1: Not establishing a great enough sense of urgency

From a Kotter perspective the change process failed utterly on this point. Not much energy was used to explain why the change process was necessary and in a hurry. So why didn't the change process get a rocky start and how did it happen that there was a committed corporation of many individuals even early in the process? After years of steady decline, frustrations among the people of not having the chance to prove the true qualities of Entreprise were distinct. When the signal came from the new management that they intended to put up a fight for Entreprise's future, people responded sceptical due to past experiences of feeling let down but basically supportive. The general question was not "is this really necessary", but rather "do they really mean it this time"?

Therefore, **trust** was the key word in the first step – not urgency – and when handling the change from bureaucratic to business the authors recommend the first step to be: Inspire trust in the future.

Error 2: Not creating a powerful enough guiding coalition

In this case the guiding coalition is formed by the Entreprise management team which was newly formed in February 2007 and supplemented by two external managers. Because of the history of the management team everybody was open to changes in their organisations. The

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guiding coalition has been very powerful and showed that they are ready to take necessary consequences if things do not work out as planned. Conclusion: Entreprise effectively dealt with Kotter's potential error 2.

Error 3: Lacking a vision
The new vision of Entreprise is clear, appealing and very ambitious, so to start with the conclusion: Entreprise dealt effectively with Kotter's potential error 3. But before breaking down the vision in specific strategic initiatives, a new common language had to be created in the organisation. The development of management infrastructure has done exactly this and introduced business concepts like NPV, productivity, targets, customer focus, continuous improvements and projects. This new common language was necessary in order to break down the vision into 19 strategic initiatives that together form a coherent business strategy for Entreprise aiming at growth. When handling the change "from bureaucracy to business" it is therefore the recommendation of the authors to introduce a new step 3 in the change process: "Build a common business language".

Error 4: Undercommunicating the vision by a factor of ten
The interviews revealed that this is one of the main concerns of the management team and there is a wide spread feeling that the vision has been under communicated even though a large part of the organisation has responded positively to the change process. Conclusion: Kotter is right about this, it is very easy to underestimate the need for communication of the vision and communication is an ongoing task. The management team still has a lot of communication to do.

Error 5: Not removing obstacles to the new vision
The interview with the management team revealed two sides to this potential error in the change process: On the one side there are very powerful examples of obstacles having been removed effectively. An example is from the spring 2008 where maintenance crew and a construction crew were careless about their responsibilities. Only one year ago this kind of behaviour would have been tolerated due to lack of spirit, but the management team acted with a firm hand in a difficult situation setting examples. On the other side small, but irritating obstacles were reported in the interview as seemingly very difficult to get rid of. Examples with administrative procedures were mentioned. Conclusion: Keep focused on continuous improvements by motivating and empowering the organisation to act.

Error 6: Not systematically planning for and creating short term wins
After the "annus horribbilus" in 2006 a new business development and sales unit was established to create a fast turn around of the negative trend in sales. The business development and sales unit succeeded and to build a sense of success in the entire organisation a bonus system introduced late 2007. All full-time employees get the same amount in bonus, no matter title or position. The bonus was paid for the first time in the spring of 2008 based on the good results in 2007. Conclusion: All employees have a personal experience of a short term win and the consequence of high business performance.

Error 7: Declaring victory too soon
The process is still so young that the temptation to declare victory is limited. But the temptation will grow as time passes and more excellent results appear. Conclusion: The management team must resist the slowly rising temptation to declare victory and be aware of signs of self-sufficiency in the organisation.

Error 8: Not anchoring changes in the corporations culture
This is still premature to the process but underlines the importance of creating new systems, processes and procedures that supports and materialise the changes.

The conclusion that can be drawn from the examination of Kotters eight errors in change processes above, is that the change process in Entreprise is basically on track even though important adjustments must be made. The examination has also pointed out that the change from "bureaucracy to business" has special traits that need to be addressed to achieve success. And the authors believe that the special traits of the change from "bureaucracy to business" reported in this case have a generic nature.

7. Reflections on the next step in the transformation

Even though Kotter´s well-arranged framework offers a very valuable help to practicians on how to plan a change process in 8 steps (e.g. Kotter 2007) further reflections concerning the complexity and dynamics in a change process will also be of high value in practice. In the case of Entreprise, this reflection was achieved through an intensive dialogue amongst the management team and between the management team and Entreprise's external management consultants. In this process, the model presented in figure 2 was developed based on common sense and past experiences of the people involved. The model focuses on the management perspective of a change process and has been helpful in defining, developing and communicating the necessary management infrastructure to support the change process in Entreprise. However, the model does not capture the soft elements in the change process, e.g. customers, leadership, people. In the context of an excellence strategy, Dalgaard & Dalgaard (2006; 2007) have defined a 4P quality strategy for breakthrough and sustainable development. This framework puts a people-oriented perspective on organisational excellence through the 4 factors on different organisational levels:

- People (individual level)
- Partnerships (team level)
- Processes (organisational level)
- Products/services (organisational level).

To implement the 4P strategy, Dalgaard & Dalgaard (2007) suggests crafting a plan that enables people to carry through improvements that should have impact on at least one of the following processes on the organisation:

1) People relationships,
2) Production, delivery and marketing,
3) New product development and
4) Administrative and support processes.

In the case of Entreprise, the interviews showed that the main concern of the management team is now process management and involvement of people in continuous improvements. The 4P strategy offers a well documented framework to address this issue and it corresponds well with the transformation "from bureaucracy to business" based on an excellence strategy as in the case of Entreprise.

8. Conclusion

So far the change process has been successful and remarkable results have been achieved, but there is still a long way to go.

A change process like Entreprise's is extremely complex and it is hard to give simple answers as to why it works in Entreprise. Many organisations have struggled hard with the change from "public to private" and there are examples of Danish organisations that have been closed down in the process. In the case of Entreprise a skilled management team with the right chemistry, a thorough planning process capturing the specific traits of the change and hard

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work has undoubtedly contributed to the success so far. But good timing and a fair share of luck has also been important factors in building up and maintaining momentum in the change process.

If we are to single out one factor as to why the change process in Entreprise had a start over any reasonable expectations it is because we have managed to stay focused on what really matters in a change process: People!

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"Equipping the future quality practitioner given expert characteristics and future manufacturing and e learning developments"

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Abstract

Purpose: This paper reports on an investigation undertaken across five countries to elicit what the perceived traits and characteristics of an expert in Quality and in conjunction with these traits, to understand what role technology may play in the provision of education of quality experts in the future.
Methodology/Approach: A questionnaire which investigated what quality practitioners and managers in Small to Medium Size firms perceive to be an 'expert' in quality was developed. A semi structured interview based on this questionnaire was the method of deployment in twenty Small to medium size organisations from Spain, Poland, Greece, Sweden and Ireland. The questionnaires were translated into the national language for each participating country and the results were then reverse translated back into English.
Findings: Most surprisingly perhaps the expert characteristics that defined an expert quality professional were significantly biased towards soft or networking building skills as opposed to skills with an analytical base. This will have a significant impact both on how quality professionals work and in how training is delivered.
Research limitation/Implication: The survey results indicate that a 'Pareto flip' in the provision and focus of education is required. Given how the manufacturing environment is expected to change, provision of tools and techniques that will facilitate employees learning the skills required to deploy quality in a virtual and networked learning and manufacturing environment is critical.
Originality: This paper researched what the possible futures in both manufacturing and e-learning are to understand what environment the quality professional will be operating in and possible modes of deploying these requisite skills.
Keywords: E-learning, Novice to Expert, Quality Management, Barriers to uptake, Learning companions.
Paper Type: Conceptual

1. Introduction

The paper is organised into seven sections. Subsequent to the introduction: section two investigates the role of the Small to Medium size Enterprises and more specifically, the role of the TQM practitioner or 'Quality Manager' within these firms Section three discusses a proposed framework to assess the attributes and characteristics that are core in the definition of a quality expert, namely the novice to

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expert trajectory and uses this as a means of defining what the key learning outcomes for education aimed at up-skilling this subset of learners in SME's are an what the perceived barriers to uptake of training are.

Section four puts forward the research instrument, its construction, rationale, testing and means of deployment across the five participant countries and provides an overview of the results obtained.

Section five discusses the results of the survey, namely what are the characteristics and traits of an expert in quality and what are the individual and organisational barriers to adopting the training required to attain this 'expert' status.

Section six investigates what the future holds for manufacturing environments and what possible developments in e-learning are.

Section seven presents a synthesis of the research, given individual and organisational barriers to uptake of learning in SME's, What is required to become an 'expert' quality practitioner and future manufacturing and e-learning technologies what are the implications for the SME professional wishing to become expert moving into the future?

2. The Role of SME's and Quality Managers.

SMEs are defined officially by the EU as those with fewer than 250 employees and their annual turnover may not exceed €50 million. SMEs account for a large proportion of Europe's economic and professional activity. In practice, 99% of businesses in the European Union are SMEs, and they provide two-thirds of all private sector jobs. So small firms are, in fact, the real giants of the European economy. Micro-businesses (those with fewer than 10 employees) dominate employment in countries such as Italy (47%) and Poland (41%), whilst the share of large enterprises in total employment in the United Kingdom is just 46% [1]. It is these firms and their employees that form large swathes of Europe's economic landscape. Manufacturing industries which constitute a large proportion of these SMEs have recently found themselves in a challenging economic climate. Between in 1995 and 2004 in Ireland, employment in the services sector increased by 58% in comparison to growth of the manufacturing sector of just 5.6% [2] and the EU15 has lost approximately 1.5 million manufacturing jobs since 2001 [3]. Critical to the long term survival and prosperity of these firms is their ability to apply tools and techniques which ensure their effectiveness in production and distribution of goods regionally, nationally and internationally. "Production as a process that simultaneously involves the material transformation, human labour and value creation necessarily depends upon the skills and knowledge of individual workers and on the collective knowledge of a range of social and technical conditions and processes that makes production possible.[4] Identifying the employees that are responsible for instigating the tools and techniques within these firms ensures the continued existence of these firms and will continue to support these firms is therefore critical in a long term strategy to support within company development.

The mainstay of quality deployment in both large and small industries is the suite of tools collectively known as "Lean Manufacturing" this incorporates concepts of total quality management such as Value stream mapping (VSM), Total Preventive Maintenance(TPM), Error proofing, Visual management and rapid changeovers, all underpinned by an ethos of continuous improvement. Several research studies have shown that lean manufacturing produces higher levels of quality and productivity and better customer responsiveness [5],[6], [7] By implementing lean principles TRW Automotive electronics group has reduced man days lost by 81%, reduced the time to

move raw material by 61%, increased production inventory turns by 28% and decrease capital expenditures by 71%[8]. At John Deere, application of lean tools has facilitated the introduction of a Just in time material delivery system and a pull system of production [10]. At Lockheed Martin Missile and Space corporation they are infusing lean technologies into all their satellite production efforts resulting in significantly reduced production costs and program cycle times cut by 50%[9] These are but a few of reports from manufacturing industries on the gains achieved as a result of application of Total Quality Management Techniques. The benefits accrued as a result of application of lean tools in large scale manufacturing are directly transferable to SMEs and support for the phenomenon is long overdue. Economies require a human infrastructure of knowledge workers who can apply their intelligence in production, but the education and training system must be a learning system that can facilitate life long learning and provide the high levels of group orientation and teaming required for intensive economic organisation. [11] Thus, the cornerstone of the foundation of these firms is in the individuals who are responsible for ensuring the long term competitiveness of the firms. The quality manager. While the tools and techniques for quality management have been comprehensively identified, the key traits and characteristics of the individual have not. The research posits that identification of the traits and characteristic of a quality expert should form the key learning outcomes of education focused on up-skilling these managers and will then investigate if these key characteristics can be nurtured given future projected manufacturing and e learning environments. Identification of quality expert skills and attributes in turn builds towards the requirements for developing SME's that in turn lead to "Knowledge creation, continuous improvement, knowledge as a source of value and synthesis of innovation and production" [11]

3. The Novice to Expert Trajectory.

Banners' model of skill acquisition [15], based on ascending levels of proficiency, was originally developed by Dreyfus and Dreyfus [16]. According to this model, nurses pass through five stages of career development: novice, advanced beginner, competent, proficient and expert. This model can be directly transcribed to the quality practitioner. "Learning in all domains is a lifelong process that can be monitored, assessed and scaffolded. The linear progression as described by Benner can also be visualised as a framework or "scaffold" through which practioners need to move through and build if they are to attain this status of expert. Lajoie [14] states "Models of expertise can assist us in determining what to monitor, how to assess, and where to scaffold learners so that they eventually become independently proficient in their chosen fields" The means to understand how to educate individuals in this independent proficiency lends itself in turn to a high level of mobility and transferability of skills nationally and internationally. The novice to expert trajectory was chosen as the vehicle for means of assessment as it has high face validity and comprehension level of the term between academia and industry is high. A clear definition of Expert at this juncture is vital however. Foley & Hart [17] define the term expert as "someone who has attained a high level of performance in the domain as a result of years of experience" and Nuccio [18] has defined experts as "those who have mastered the perceptual, motor, cognitive and interpersonal skills necessary for performance with a few to no errors". For the purpose of this research, an expert in the context of quality is defined as "An individual who has acquired the knowledge, skills and aptitudes required to effect deep and sustained organisational changes driven by tenets of applied total quality management principles" This is what

facilitates moving the organisation from the effects of low level learning to gaining the more profound benefits to be had from higher learning. The moving of a sufficient number of key individuals within the firm along this Novice to expert trajectory[Figure 1]
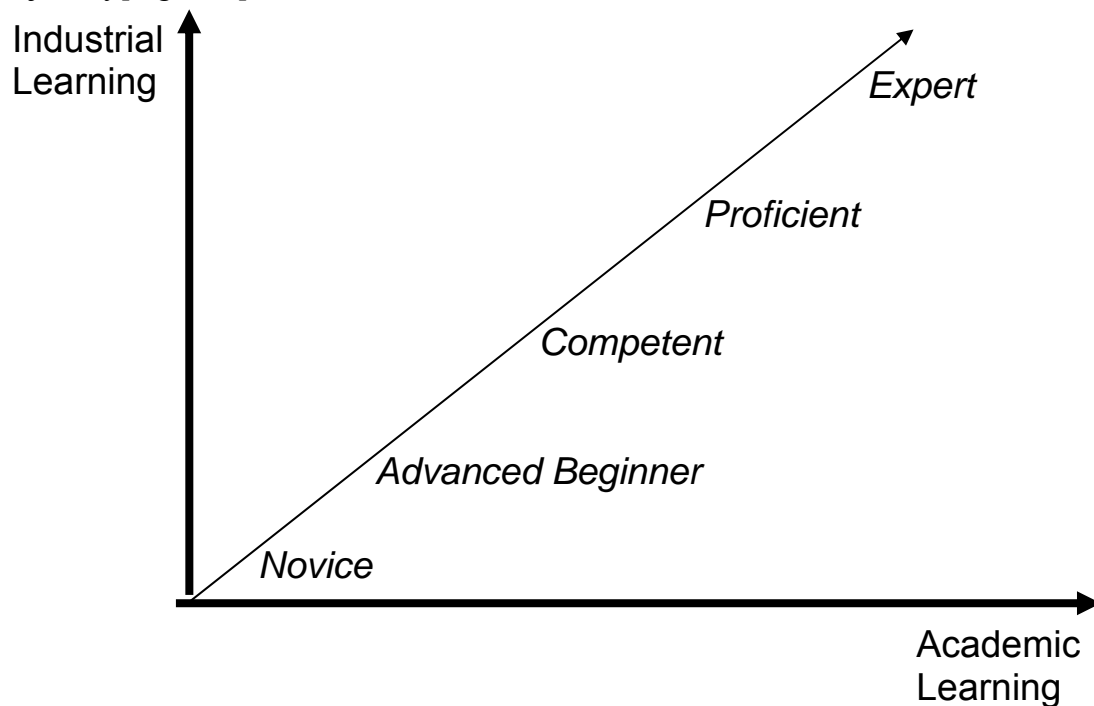

Figure 1: Novice to Expert Learning Trajectory.

4. Research design and deployment.
Based on these prior definitions of expertise and a previous study carried out by Cone and Murray[19] to investigate the characteristics of expert triage nurses as a comparison, A questionnaire was constructed which included questions designed to elicit;

a) Personal traits/Behavioural attributes   (Q1 – Q3)
b) Knowledge   (Q4 – Q6)
c) Business Competencies   (Q7-Q10)
d) Individual barriers to uptake   (Q11)
e) Organisational barriers to uptake   (Q12)

Given that novice learning tends to happens through repetition in a well understood context that focuses on problem solving skills it then becomes possible to understand what is required to move from novice to expert and to build or 'scaffold' a learning program based upon these requisite competencies as each will change depending on what level of expertise has been achieved. This includes skills such as use of heuristics, insight, a focus on problem definition and alacrity in applications of TQM tools and knowledge in ambiguous settings.. The questionnaire was validated by pre testing on individuals with operational and academic experience in Quality deployment. The mode of enquiry chosen was qualitative interview based research using semi structures questions to guide the interviewee. This method was chosen over a quantitative means of assessment as a questionnaire containing prescribed responses with likert type scaling would have artificially limited the range and depth

of response the study was looking to obtain. The study stipulated that the respondents were working in the quality function in their respective SMEs Each of the five participant countries translated the questionnaire as required into native languages and pre validated the instrument in their own institution. The same instrument was used in each participating country and a table of comparison was drawn up to compare and contrast responses to the interview questions.

5. Results

In total five countries participated in the study, Poland, Spain, Greece, Sweden and Ireland. The following presents sample findings from this preliminary investigation into the characteristics and attributes of the Expert practitioner in quality. The responses to selected questions are structured for comparison by adjective comparison and an analysis to the key response findings is presented:

Q1) What personal qualities and characteristics are innate in quality experts?
The most commonly recorded adjectives used by respondents to describe a quality experts characteristics ranked by the number of times the word appeared were; communication skills, organisational ability, analytical, perspective, insight, leadership and motivational skills. There were a large number of once off terms that were not necessarily repeated but that fell into a classification. In total 94 adjectives were used across the 5 countries. A first run organisation of the data uncovered that the characteristics described could be naturally categorised into three overarching group headings, namely:
a) Interpersonal skills including communication and ability to motivate,
b) Character based skills including assertiveness, humility, diligence, insight, ambition
c) Cognitive constructs including Engineering, problem solving, systematic

Q2) How do experts organise information and relevant data?
Most commonly recorded adjectives in response to this question included deep analysis of crucial data, that data was organised by regulatory requirements as per ISO or QS system accreditation requirements, that all data is stored in a systematic and organised way and that data was not just analysed for resolution of problems but that it was analysed for innovation or improvement also. Use of databases and information filtering methods. Collecting, processing and storing of data in a systematic and organised way. Ability to move from detail to broad perspective and understand the strategic significance. They understand statistics and the inter relationships between data. Has knowledge of information generation and problem analysis. Responses to this question could be categorised into two themes:
a) The physical and logical means of data collection and storage.
b) The means by which the data was mined and analysed for meaning

Q3&4) What are the academic and professional qualifications required to become a quality expert?
Sixteen out of the twenty respondents surveyed indicated that at a minimum an undergraduate degree was important. They also indicated that the discipline studies should make reference to development of analytically orientated skills. Five

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respondents indicated that a masters level qualification was prerequisite to becoming an expert in quality. Opinions with respect to what professional and academic qualifications were required were more contextually embedded in each organisation as there was wide 'within country' variances in response to this question.

Q5&6) What other domain knowledge/training is required to be a quality expert?
Repeatedly a sound knowledge of productions methods and processes emerged as key knowledge however also consistently expressed that knowledge across other functional business areas including technical design, marketing, sales, supplier and customer relationship development/negotiation was critical. Responses were delineated in two categorisations:
a) Interdepartmental experience including operations, sales, marketing, HR etc.
b) Negotiation and customer and supplier development orientated knowledge.

Q7) What internal/External business resources do experts rely on?
Responses included being part of a strong internal and external company network, having complete and full backing from senior management, support from related departments and training. Four categories emerged in response to this:
a) Internal support network including other departments.
b) External company networks of support
c) Top management support critical to carrying out role
d) Training resources.

Q8) What business competencies and skills do quality experts bring to their role?
Emotional intelligence. Firmness, focus, courage, inquisitiveness, in depth analysis, communication, interpersonal skills, responsibility, project management and problem solving expertise, ability to translate strategy into action, The ability to present data, connect functions, deep knowledge of validation and verification, practical experience in system implementation, leadership skills, sales experience, operational management experience. Separating the responses into headings mirrored the results from question one. Indicating that managers used the same assessment set for business skills to be brought to a role as they did for assessing the innate characteristics of the quality manager.
a) Interpersonal skills including communication and ability to motivate,
b) Character based skills including assertiveness, humility, diligence, insight, ambition
c) Cognitive constructs including Engineering, problem solving, systematic analysis.

Q10) Can you best describe how a quality expert reacts to unexpected challenges at work?
Respondents again yielded a very broad spread of responses to this question, ranging from: The ability to look at problems from a wider perspective, that they listen to and collect facts, ability to find root cause of problems and put in place measures to ensure issue does not re-occur, adopts a long term perspective to problem solving. Ability to prioritise and communicate issues effectively, that they are calm and collected and will take sufficient time to understand a problem fully before deciding a strategy, remains composed, understands which relationships and quality tools to use to resolve issues effectively. Categories of response to this question include:
   a) Ability to analyse problem and all possible effects
   b) Ability to apply correct problem solving technique

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c) Use of interpersonal skills to communicate, delegate, prioritise and organise
d) Character qualities including composure and perspective.

Q11) Individual Barriers to adoption of e-learning:
Individual barriers to adoption of e-learning centred around three core themes, in order of how these appeared were:

a) Sufficient time
b) Knowledge of availability
c) Interest or relevance to job applications

Q12) Organisational Barriers to adoption of e-learning
a) Large resource allocations in terms of labour hours
b) Prohibitive cost
c) Questions as to the quality or recognition of online learning courses.

Both sets of concerns, individual and organisational must be tackled if e-learning is to become a dependable, recognised and widely available educational resource for the quality professional, particularly for SME's who are less well able to absorb the impact of poor learning outcomes.

6. Future state of the art in e learning and e-manufacturing, implications for moving learners in quality along the novice to expert trajectory.

Manufacturing research, in keeping with objectives as stated by the manufutures platform [13] has identified a number of pillars around which manufacturing research should centre, these including focusing on new, high value added products and services, business models and transformation of existing R&D and educational infrastructures to support world class manufacturing technologies fostering researcher mobility and lifelong learning. The virtual factory of the future will manufacture in adaptable networks linking OEMs with equipment suppliers, value chain partners and services selected according to need at any given time. Its composition will not be limited by physical co location, nor by a need to maintain rigid long-term relationships. At the heart of the new enterprises will be knowledge management, network management and relationship management based on trust and ethics. [13], [19] But how will this manifest itself for the professional in quality management? It is posited that the gap between the working and learning environments will merge and that the quality practitioner will need to understand how to be effective in an environment that can be described by and will depend upon technologies that use [20]:

a) Intelligent agents for continuous real-time remote, distributed and web based monitoring of and analyses of devices, machinery and systems
b) Remote, distributed and web based quality control systems integrated with intelligent predictive agents
c) Dependable and scalable information platforms for complete transformation, optimisation and synchronisation of plant floor problems, issues and solutions

d) A virtual design platform for collaborative part, process and tooling design amongst designers, suppliers and engineers as well as rapid part and process validation.

If this is the perceived future of manufacturing, the future state of the art in e-learning according to recent studies include incorporating learning theories such as responsibility sharing [21], socially distributed cognition [22], reflection and articulation [23], reciprocal learning and learning by teaching [21] and weaving them into concepts for e learning that include the use of agents and learning companions[26] An 'learning companion' is a computer simulated character which has human like characteristics and plays a non authoritative role in a social learning environment, an 'educational agent' is a kind of computational support which enriches the social learning environment either by providing virtual participants to enhance the member multiplicity of communities or foster communication between among real participants, parents, volunteers, teachers and books and other educational resources[24]. If technology is to support the merging of the learning and work environments, then these agents and companions as will need to flex to highly contextualised work environments to guide, support and mentor the SME quality practitioner through this distributed networked environment of people services and processes to become experts in deploying the total quality management principles. According to the research, these agents and companions will need not only to guide the quality expert in these domains to ensure learning outcomes are achieved, but will also need to cater for not only the learning and deployment of TWM principles, but must also cater to imbuement of the characteristics as described in the results of the questionnaire. The question is whether it is possible to design learning so that these qualities can be remotely learned, contextualised to match the environment that the learner is working in such a way that communication is effective and personal instead of the psychological and relational distance often imposed by use of such technologies. In future, integrated delivery systems that promote learning and flexibility will be better prepared to face the challenges imposed by a complex and competitive environment. [25]

7. Discussion

We have entered the perfect 'Electric storm' where technology, the art of teaching and needs of learners are converging [26], Use of the novice to expert trajectory proved a valuable tool in assembling the various constructs or scaffold that will contributes to delivering an education towards an individual achieving a title of future expert in quality practitionership given technology enabled learning and manufacturing environments. Of significance was the preponderance of 'soft' or relationship building skills in response across the three areas of research, innate characteristics, and knowledge and business skills. On average adjectives describing the ability of the quality expert to negotiate, listen, understand, lead and motivate were consistently referenced to by respondents. The age old chestnuts of lack of time and cost to engage in e-learning emerged along with concerns as to the quality of learning as the prime barrier to adopting e-learning courses These results when combined with the technologies currently under development for learning and manufacturing make a fascinating combination. The possibility of agents and learning companions which can adopt different teaching methods depending on the learners needs being used to

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guide these learners through educational resources adapted for the context specificity in which the quality professional operates is limitless.

In conclusion, the results of the research also brings to the fore another question. The current syllabus of quality management programs places in excess of seventy to eighty percent of teaching time and emphasis on the analytical tools and techniques required by the quality manager. The remainder of syllabus topics cover project management, accounting and an occasional module on organisational behaviour. Our results suggest that a 'pareto flip' is required if third level institutions are to provide training that is going to support the SMEs role in the economy long term. On the strength of the results obtained, significantly more emphasis is required on the teaching of competencies in negotiation, network development, information sharing and dissemination, communication, leadership and motivation. How may agents and learning companions be deployed to support these learning needs and help the SME practioners move from novice to expert? It is these characteristics with conjoined analytical skills that in the future will lead to development and mobility of future professional experts in any domain. Analysis of the skills required by the expert or even 'elite' is a succinct and meaningful way of defining what the learning outcomes of education program developed to support these employees. That delivery mechanisms that will be meaningful in the environments in which work which will benefit not only the learner, but also their firms and long term, the economy in which they participate.

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Third Generation Quality Movements: from the *stricto sensu* technique to organizational sustainability models

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Abstract

Purpose - Quality is (not mistakenly) one of the most discussed themes in the production management arena. This article analyses, based on literature review, the evolution of the quality concept, focusing on the called "third generation quality movement", which is inspired by organic and relational premises, and it is observed completely associated with the postulates related with the organizaqtional sustainability concept. As conclusion, it is noticed that the evolution of the concept justifies the creation of organizational self-assessment sustainable models.

Methodology/Approach – The methodology used in these study was based on the comparative analysis of literature review, referenced in national and international books, journals, monographs and thesis, related with all the concepts associated with sustainable excellence models, quality and organizatinal sustainability .

Conclusion/Findings - According to the analysis of the presented material and based on the observed tendencies in large Brazilian and international organizations, it is true that the evolution of the organizational management systems to the called third generation of quality is going to be a natural movement. Therefore, related to sustainable organizational management is suggested a gradual review of the actual organizational performance

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assessment, recommending, not only considerer the economic-financial criterions in the assessment , but also include social and environmental criterions in this assessment.

Key-words: *Corporate Sustainability, Quality, Sustainable Development, Excellence Models.*

Paper type - *General review*

1. Introduction

The study of Quality, as well as its basis, models and applications is one of the most common themes of discussion in the industrial engineering field, either in the academic or professional area. Its early principles of evolution, usually associated with corporate practices, makes the movement of quality one of the most relevant and fertile objects of scientific investigation, making possible purely technic analysis, like statistical sampling, and also extrapolations concerning future themes like the third generation Quality movement.

This article aims to propitiate a brief contextualization of the evolution of quality, focusing on the so-called third generation quality movement, inspired by organic and relational premisses, oriented by the organizational sustainability.

2. Literature Review

2.1 The evolution of the concept of quality

It is noticed that the concept of quality has been affected by changes and revisions throughout the years (see figure 1). Jonker (2002), (2003), Lau (1999), Mcdonald (2002) and Van der Wiele, Dale & Williams (1997) indicates that, in the beginning, the quality concept was seen as a mere control accomplished by a pure and simple final product inspection.

This concept evolves and starts to be considered as a merely statistic control, using product sampling techniques to assure this quality. In its next step, the concept starts to be known as quality guarantee, because all the company functions are seen as important parts of its success/failure of the organizational quality. In his newest concept, the quality starts to be treated as a strategic function of the organization and to be known as total quality management (TQM).
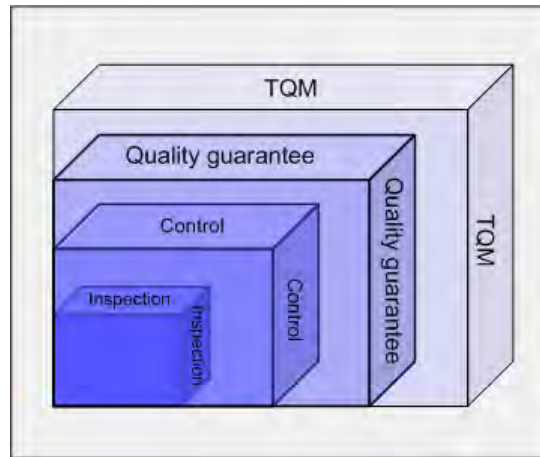
Figure 1: Evolution of the quality concept
Source: (Van der Wiele et al. 1997)

To Jonker (2003) these changes in the concept of quality – from product-oriented view to a relationship-oriented view between the product and the organization, define two generations of the so-called quality movements. Jonker characterizes them as a hard-line quality movement (first generation of product-oriented) and as a softer quality movement (second generation oriented to organization as a whole).

To Karapetrovic & Willborn (1998c), the quality does not happen in a aleatory way, it is planed , sketched, created and improved; the result is a systematic effort to reach a wished purpose. However, for the development of a quality dimension, a quality system must be used. These authors characterize a quality system as an interrelated group of processes that work in a harmonious manner to reach and exceed all the clients` expectations related to their demands or requirements, that is also known as total quality management (TQM).

Jonker (2003) indicates that TQM can be considered as a management philosophy that seeks the continuous improvement of the organization, throughout the insertion of concepts associated to quality in all its processes, functions and sectors of the organization (Lau et al. 1999), increasing his efficiency, efficacy and competitive advantage, guaranteeing in thsi way the success of the organization.

2.2. Evolution of the concept of quality: Third Generation Quality Movement

According to March (1999), Edwards, the first president of ASQ (American Society for Quality), indicates that the statistic techniques should not be focused only on the economic arena, but could also be used in other fields, like the social one. March (1999) and Zairi (2002) points that Juran also emphasizes the importance of quality serving the society. Zairi (2002) points out that Deming also extends the concept of quality, expressing that quality is not just oriented for client's satisfaction but also is looking for all the interested parts satisfaction (stakeholders).

Jonker (2002) points out that the concept of quality can have a connotation of "trash", which means that it can be applied to any object, process, function or organization,

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initializing a change in the concept definition, that was first focused only on the product, for a concept of totality, embracing all the organization. Jonker (2003) indicates that Foley's studies (1997) *in* (Jonker & Foster 2003) were the first to shows the importance of the relationships between the quality movement and the several interested parts of the organization (clients, suppliers, shareholders and employees), these studies did not considered all the interested parts of the organization, because the external interested parts where excluded.

Another evidence of change on the focus of the concept of quality can be found in (Hoyle 1994) *in* (Jonker & Foster 2003). The author defines that the quality of the organization can be visualized through three levels: [1] product and services level (clients` satisfaction) [2] business quality level (internal view - increase of the efficiency and efficacy of the organization, through society and environmental care); and, [3] Organizational Quality level (external view – Strong relationships with the environment and society.)

This same idea is reinforced by Van Marrewijk (2004) and Karapetrovic & Jonker (2002) indicating that the new objective of business is the creation of value and synergy, where the business focus not only on the clients, but in all the interested parts, including in this vision the social and environmental aspects. These new proposal indicates the importance of the inclusion of the concepts associated with the corporate social responsibility and corporate sustainability in the organization. Van Marrewijk shows that the corporate sustainability and corporate social responsibility concepts can be build though the basis of the quality management and excellence models concepts.

Karapetrovic & Jonker (2002) indicates that the quality management system can be visualized as a subsystem that pertains to a major system, where a series of other systems are included, all been oriented to the satisfaction of the several interested parts of the organization (stakeholders). Jonker (2002) also refers to the importance of the inclusion of the socio-environmental factors into the quality management systems, ‚Jonker indicates that the incorporation of this factors (social and environmental) , marks the beginning of a new concept called third generation quality movement, defining it as MQM (Modern Quality Management).

Wilkinson (1999a) points out that organizations, besides focusing on the satisfaction of their clients` needs, should start to worry about other kinds of factors like: well-being of their employees, work environment, the impact that the products and services produce in the neighborhood and local communities, as well as the effects caused by the use and discard of these products or services.

Wilkinson also points that the interested parts themselves are becoming more and more worried with those kinds of things, and that is the motive why the organizations are using different methodologies and tools to guarantee the satisfaction of their clients as also of all the others interested parts. This situation, implementation of a series of methodologies and tools – may bring to the organization the necessity to have a all branch of management systems. Wilkinson (2001), in his paper, proposes the utilization of a single integrated management system (IMS) embracing all the methodologies and tools associated with quality, environmental and society aspects of the organization.

In this same line of thought, Waddock & Bodwell (2002) indicates that, due to the

pressure of the several interested parts and also the globalization movement , organizations are beginning to include other factors besides the economic in their management decisions, been this the reason why they are starting to implant management systems that can help to manage the relations with all the different interested parts (stakeholders). To Waddock & Bodwell these new management systems are starting to co-exist in the organization with the quality management systems. For this reason, the above authors propose an expansion of the concept of TQM to the concept of TRM (Total Responsibility Management), that starts to contemplate the necessities and requirements of all the interested parts that interact with the organization (stakeholders) forming just one integrated management system that will consider the social, environmental and quality aspects of the organization.

We can conclude that the so-called third generation quality movement is based on the inclusions of social and environmental variables into the actual organizational management models. Jonker (2002), Van Marrewijk (2004) and Waddock & Bodwell, (2002) indicate that the changes in the organizational management systems should start through the changes in the organization pillars (values, basis, view, mission), transforming the organization as a whole, defining new ways of work, new purposes and goals, and also new evaluation tools that will have to include the evaluation of the social and environmental factors. This idea is reinforced by Castka (2004) who defends the idea that whatever the management model implemented in the organization, it should be treated as a change in the organizational philosophy, embracing all the aspects that exists in the organization (values, principles, strategies, process and so on) .

2.3 Models´ implementation towards the third generation quality movement

We can evidence a tendency to the expansion of the concept of quality (TQM) for an embracing concept where the relationships of the organization with the environment and the society can be evaluated. However, it is important to question the insertion the insertion of these new variables in the organizational management concept.

Karapetrovic (2003) and Dale & Wilkinson (2001) refer to the existence of several research and papers oriented to the analysis of different ways of moving from the second to the third generation of quality, indicating the necessity to define ways of helping the organizations with the implementation of these new ways of management.

Dale & Wilkinson (2001) demonstrate the existence of two possible ways of passing to the third generation of quality. The first one occurs through the integration of several management systems into a major integrated management system that will embraces all the management systems (quality systems, environmental management systems and also health & security management systems) in one. The second one occurs through the expansion of the concept of TQM, where the social and environmental factors would be considered been part of all other client's need, so not only client requirements will be accomplished, but all the interested part (stakeholders) requirements will be accomplished.

Karapetrovic follows Dale & Wilkinson's ideas, indicating that this passage to the third generation of quality can happen through two different ways of movement directly associated with the quality concept definition.

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Karapetrovic (2003) defines quality as the ability that the organization possesses to satisfy the client necessities. Analyzing this definition, Karapetrovic indicates that the first way in this evolution (from the second to the third quality movement) happens when the organization not only seeks to satisfy its clients needs, but also all the interested parts needs. The second way of movement occurs due to a a change in ability to satisfy the clients necessities – this ability turns a simple satisfaction of the client's need to a full excellence satisfaction of that same need (see figure 2).
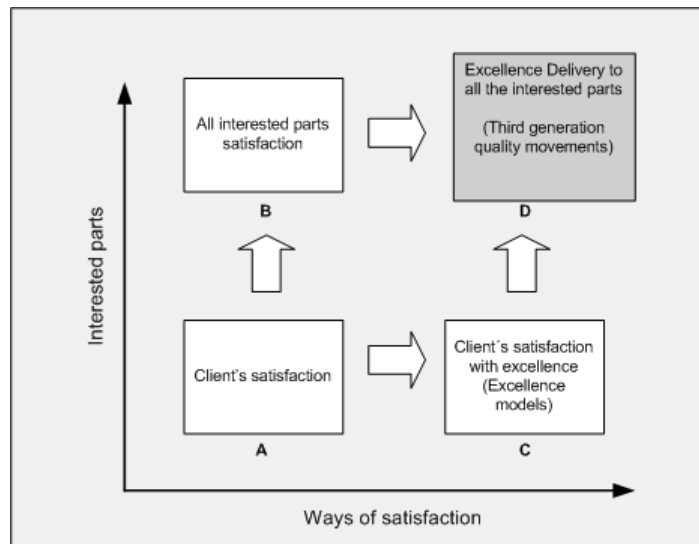
Figure 2: Evolution of the third quality movement
Source: [(Karapetrovic 2003)

When figure 2 is interpreted, it is observed, in the first path, that the organization starts satisfying some clients` needs through the implementation of some management system (point A); in the moment that the organization starts worrying about other interested parts (establishment of other systems as ISO 14000, OHSAS 18001 and others), the organization evolution begins, passing through point A to B. In the moment that the organization realizes the necessity of a integrated management system (IMS), a transition would have happened from point B to point D, distinguishing the third generation of management systems.

The second way of transition happens when the organizations initiates its pathway to excellence (total satisfaction of clients` needs), passing from point A (quality management system) to point C (excellence system focused on the client). In such case, when the organization starts worrying about the satisfaction of other interested parts besides their clients, it would be passing through point C to point D, characterizing the third generation of quality.

Another line of thought is presented by Keeble (2003), Searcy (2006) and Neely (2000a) pointing out a existence of a third way of transition to achieve the satisfaction of different interested parts. This third way would happen across a dialogue with the different interested parts, identifying, through this dialogue, their requirements and necessities of these stakeholders, the appreciation of this necessities would have an important roll in the

strategic planning of the organization and at its operational processes. Among this new alternative, the Karapetrovic scheme can be reformulated, incorporating a new transition, that would happen directly between points A and D (see figure 2).

With the incorporation of this new vision, can be identified three transition movements from the second generation of quality to the third generation of quality: (see figure 3):

a) Through the integration of different management systems that exists in the organization;

b) Through the extension of the excellence concept to excellence concept that includes the social and environmental aspects;

c) Through the dialogues with different interested parts of the organization.
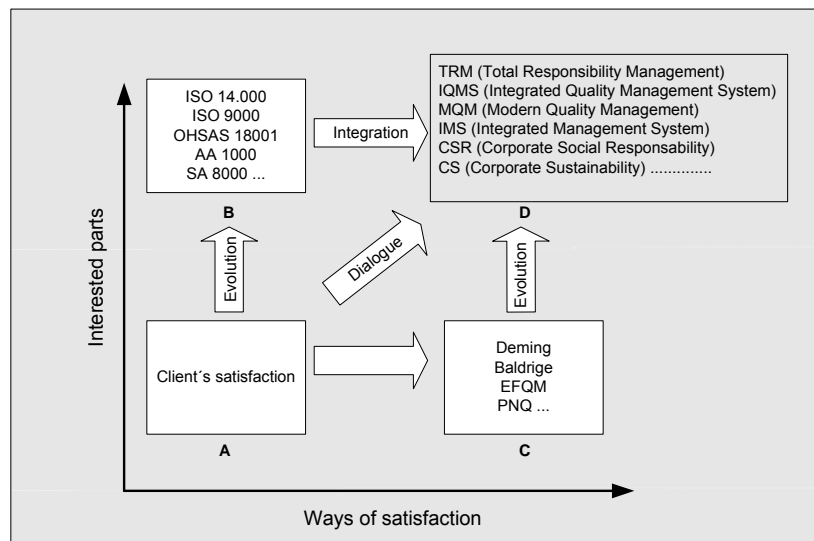
Figure 3: Three paths to the third quality movement
Source: Adapted from [(Karapetrovic 2003)

2.3.1   Third Generation of Quality through the integration of management systems

Karapetrovic & Jonker (2004) show that integration, across the use of different norms (management systems) can be done either by the creation of a new norm that will contemplate, quality management , environmental and health and security management aspects into a   generic management system standard (GMSS) or by the integration of different norms existing in the organization (IMS – Integrated Management System).

Wilkinson & Dale (1999b) go deeper in this ideas of Karapetrovic & Jonker, indicating the existence of three models for the integration of these different norms:

- Management system evolution model presented by Renfrew& Muir (1998) *in* (Wilkinson & Dale 1999b);

- Model of Karapetrovic & Willborn (Karapetrovic & Willborn 1998a), known as classical model of the ISO;

- Integration model presented through two similar ideas, the first one from MacGregor (MacGregor Associates 1996) *in* (Wilkinson & Dale 1999b) and the second one presented by the ISO/TAG 12 (1998) *in* (Wilkinson & Dale 1999b).

2.3.2. Management system evolution model by Renfrew e Muir

To Wilkinson & Dale (1999b), the model of Renfrew & Muir is based on an evolution of the different norms implemented by the organization. The authors explain that almost all the organizations starts implementing one or some of the norms (management system): in the specific case of this paper we will use like a example the ISO 9000 implementation (see figure 4) , this implementation is defined as stage 0 of the model.

Whith the implementation of this norm, another stage begins (stage 1), that is the incorporation of other norms into the organization (ISO 14000, OHSAS 18000 and others); the next stage (stage 2) is referred to a semi-integration of the existing norms (known as ISO Matrix). This integration identifies the similarities in the different procedures of th norms,. The third stage gives to the organizations a view of the different procedure that can be integrated (identified in the previous stage). The fourth stage corresponds to the integration of this procedures into one integrated procedure, passing in this way to the last stage (stage 5), which talks about the creation of an integrated system, that would have all the procedures defined and implemented in organizational processes.
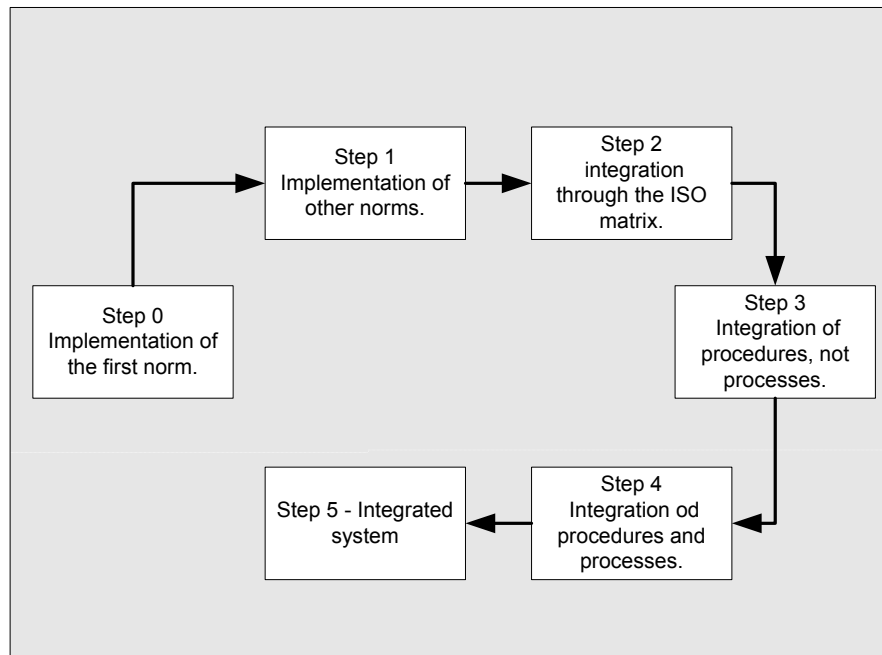
Figure 4: Adapted from the evolution model Renfrew & Muir
Source: Renfrew & Muir (Renfrew & Muir 1998) in (Wilkinson & Dale 1999b)

2.3.3. ISO Matrix Model of Karapetrovic e Willborn

The second stage of the model presented by Renfrew & Muir (1998) *in* (Wilkinson & Dale 1999b) refers to the ISO matrix integration. In this second stage, an association is done between the different norms´s sub-classes and the identification of the similarities in each one of them. Beechner (1997) and Wilkinson (1999b) presented and example of this work, making a comparison between the norm of the ISO 9000 and ISO 14000, indicating the common procedures of them.

Another aproach presenting the integration of managment systems is through the ISO matrix defined by Karapetrovic &Willborn (1998b), this authors indicates that the organization has to be considered like a system (see figure 5) and the management systems implemented in the organization should follow this systemic orientation. Wilkinson & Dale (1999b) indicate that the systemic vision of Karapetrovic & Willborn has seven stages (Requirement, System Drawing, Attribution, Construction, System Implementation, Exit, and; Assessment), which can be compared to the Deming PDCA cycle (Plan, Do, Check , and; Act).

Karapetrovic & Willborn indicates that, in this systemic vision, different management systems could be implemented and be treated in parallel, but always should be followed the seven stages defined in their model. They present an example of this idea indicating how the ISO 9000 e ISO 14000 implementation would remain using this model.

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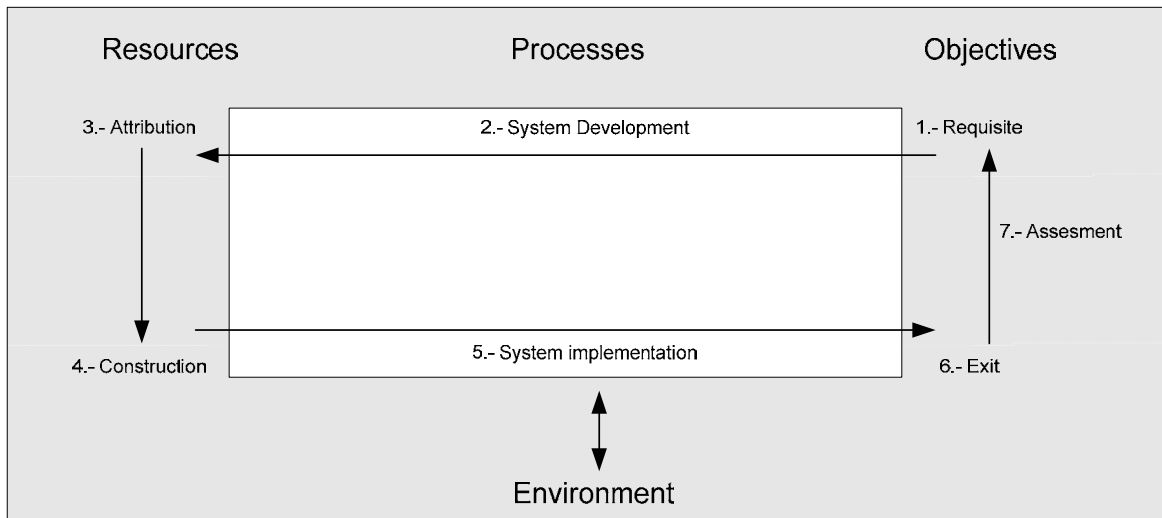
Figure 5 : Karapetrovic & Willborn Systemic view
Source : (Karapetrovic & Willborn 1998b)

2.3.4. Discussion of Macgregor model (Integrated) and ISO/TAG 12 model (Lined up)

The integration models defined by MacGregor (1996) and ISO/TAG 12 (1998) *in* (Wilkinson & Dale 1999b) does an integration of the norms across two similar ways: the first one, defined by MacGregor, is known as integration model and proposes the creation of a central nucleus that will contains all the similar requirements and procedures of the norms that already exist in the organization and also of the future norms could come to exists, all the requirements and procedures that wont fit in this nucleus would stay in specific nucleons created for each norm.

The second model of integration is defined by the ISO/TAG 12 group (Technical Advisory Group 12) of ISO (International Organization for Standarization) and is known as lined up model. In this model, opposite of the previous one, would not have a central nucleus, but specific management systems for each norm, all of them working in parallel (like how exists today). The difference about the norm implementation is about the fact that each management systems would have a high degree of compatibility between each of the norms (as a example ISO 9000 and ISO 14000). Under this approach, the common elements of each norm would be similar in all the norms, allowing an easier way of implementation.

2.4. The third generation of quality through the extension from the excellence concept to the sustainable excellence concept.

Excellence is seen as a synonym of TQM, the excellence or TQM concept is applied into organizations through the different BEM (Business Excellence Model) models existing in the world. These models present a methodology that, through the use of an self-assessment tool, help the organization to measure his degree of adherence with respect to the focused model. Through the incorporation into this models of the concepts associated with the sustainable development approach (due to stakeholders pressure or competitive structure of the market) the third generation of quality concept could be constructed

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Edgeman, in his article "*Measuring Business Excellence: an expanded view*" (Edgeman 2000) exposes a general vision of the proposal of an excellence model that considers, beyond quality, social, environmental and technological factors. Edgeman called this model "BEST Business Excellence", in which BEST refers to four basic components of the excellence sustainable model proposed by him: B –Biophysical; E – Environmental; E – Economic; S – Societal e T – Technology (Hensler & Edgeman 2002). This model, according to Edgeman, tries to combine the concepts of sustainable development with excellence models.

Edgeman indicates that the basis of excellence models (or the measurement of the performance) is found in the principles and criterions defined in his model, and, through them, the organization will be able to orientate the pathway to excellence. He also indicates that his model is based on the insertion of socio-environmental principles and criterions. Across them, the organization could evaluate the degree of adherence to entrepreneur sustainability based on BEST (B – Biophysical; E– Environmental; E – Economic; S – Societal e T – Technology).

This relation between sustainable principles and excellence models can be found in the model of McAdam & Lambert (2003). For them, the organization should identify principles and sustainable actuation values (see figure 2-9), which would permeate all the organization processes and structures (planning, processes and results). The definition, application and measurement of these principles should be done taking into consideration different social actors with whom the organization interacts.

McAdam & Lambert (2003) use these concepts to define an extended excellence model. This model is base on the incorporation of socio-environmental sub- criterions into the actual excellence models criterions. The sub- criterions that have to be inserted, according to the authors, should consider each one of the three organizational responsibility levels defined by Wood (1991) :

a) Legitimacy : society expectations refers to all the organizations, due to their role like economic institutions;

b) Organizational: society expectations are specifically with the organizational behavior, taking into concern what it does and produces;

c) Individual:society expectations is about people that works and interacts with organization.

McAdam & Lambert propose these sub- criterion because an evaluation of socio-environmental factors would happen in all organizational processes. McAdam & Lambert reject the socio-environmental assessment through the incorporation of a new criterion (for example, sustainability criterion), because this will disrupt the assessment philosophy, since the organization would only be evaluated through this new criterion and not through all their organizational process.

In this same line of thought , Garvare & Isaksson (2001) points out that the actual excellence models evaluate the behavior of an organization, mainly oriented to the

economic factor. In this kind of model, its foundations and values guide the organization to have an exclusively economic assessment, promoting the satisfaction of only one the stockholders and clients. Based on this idea, the authors propose and expansion of the excellence models, so that all the satisfaction of all the stakeholders could happen. So, he proposes the expanded excellence model.

The expanded excellence model, defined by the authors, is based on two main premises:

a) The organization can be characterized by four types of processes, where three of them are considered facilitating processes (management, operation, support) and one is considered a result process (result).

b) The expanded excellence model can be built using the triangle "person – organization – society", in which the organizational excellence should promote individual, organizational and societal excellence.

Through these premises, the authors define both the values and the criteria of this new excellence model.

3.5. Third Quality Generation through the dialogue with different interested parts (stakeholders)

Under another vision of how this evolution could be done to reach the expanded excellence model, Keeble (Keeble et al. 2003); Searcy (Searcy et al. 2006) and Neely (Neely & Adams 2000a) points out, that this evolution can be reached through the dialogue with interested parts (stakeholders). Across this dialogue, the requisites and needs of the stakeholders are identified and implemented, either in the planning, operation or organizational results.

Keeble shows that different stakeholder that interacts with the organization manifest the will of knowing how that the organization is satisfying their needs and requisites. As examples, there are:

a) Investors willing to meet and know by evidences the actions associated with corporative governance, business strategy and risks management;

b) Clients that want to evaluate the origins of products and components utilized in their fabrication;

c) The employees look for life quality at work and companies that do not harm society (socio-environmental factors);

d) Requirements of the public and third sector, referring to the strategies and socio-environmental reports of the organizations.

Due to these facts, the organizations are realizing the importance of the application of the concepts associated with the sustainable development idea in their management. The existence of a number of principles / methodologies / tools, associated to organizational

sustainable development or corporate sustainable responsibility, makes the companies to loose their focus and utilize most of their time choosing the methodology or tool that most adequate to his organization (Keeble et al. 2003).

Keeble explains that the use of indicators is extremely important to know, measure the performance and line up the concepts of sustainable development into the organization. In this process, should not waste a lot of time choosing the right indicators, the time has to be used in the assessment process.

Keeble proposes a methodology to select the indicators that should be used, through the formulation of four questions:

a) Which are the most critical and relevant aspects for the organization?

b) Which are the commitments that the organization has to handle?

c) How is the organization going to compare its performance?

d) What are the expectations of the stakeholders?

Through these questions, the organization will be able to do a selection of the indicators that can be used. Keeble points out the existence of indicators that can measure the same situations, for that motive a procedure for the selection and filtering of the chosen indicators has to be implemented.

To Neely, (2000b), knowing the needs (demands) of the different interested parts is essential to the company, because the strategies will be structured and implemented focused in the satisfaction of these needs. In such a case, the authors propose a model called performance prism.

This is a three-dimensional model that has five faces (Neely & Adams 2000), the main ones are the satisfaction and contribution faces related to the different stakeholders (Clients, Employees, Suppliers, Government, Society) and the support ones, which are strategy face, processes and capacity faces.

To this authors, the organizational survival in the market will occurs only through the knowledge of stakeholder needs, where the satisfaction of these needs would happen across through organizational strategic implementations.

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Assessment of Competences Safeguards Sustainable Quality

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Abstract

Purpose
The quality of companies is particularly determined by the quality of processes and the abilities, skills and knowledge of the people involved. People with the necessary competences are an important factor of success for enterprises. For their survival on the market an effective organisation of enterprises and a continuous development of the necessary competences are an important condition. Due to this enterprises need an overview of the processes, the personal and process-oriented competences and the conditions to enhance learning. This helps managers to make strategic decisions.

Approach / Methodology
This paper presents a methodology that we called "competence-circle" to prepare systematically a completely process-oriented competence map. In four phases the user gets an overview of the processes and the competences. The regular application of the methodology offers the possibility to identify the improvement potential in processes, recommendations for competence development and the improvement potential to enhance learning.

Findings
The "competence-circle" was tested successfully in a small and medium enterprise, which operates in the industrial sector of management consulting. The result of the practical application was meaningful and important for the strategic development of the enterprise. But the methodology has to be tested in other conditions.

Originality
Important factors for the quality of enterprises are the process organisation and personnel with the relevant competences. Most of the existing methods only assess the personal competences, but it is also important to consider process competences. The new methodology "competence-circle" offers an easy way to assess the competences in connection with the processes. The method, tested in an enterprise of management consulting and also in enterprises of education, is successfully applicable in service enterprises.

Keywords: competence, competence development, human resources, quality

Paper type: Research Paper

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Introduction

As globalisation increases, there are more enterprises in the same fields, products become more and more similar and technology develops very fast. Thus conditions on the market change continually. One consequence is the change from material products to knowledge-intensive services (Heinich, Winzer, Winzer 2006). The customers expect not only products but also services. This forces enterprises to concentrate more on the necessary competences. People with the necessary competences are an important factor of success for companies and in future this effect will continue to grow. From a knowledge-based point of view a change of paradigm related to human resources seems to be inevitable (Figure 1). Not only technology but also the knowledge and the attitude of the people are important factors of success. (Heinich, Wank, Winzer 2003)
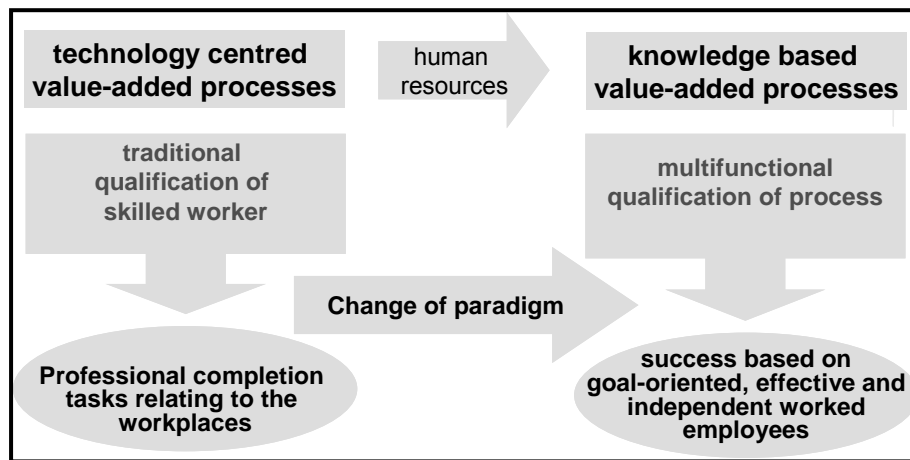
Figure 1: change of paradigm (Heinich, Wank, Winzer 2003)

This development results in new challenges that corporations as well as competitors have to face. To survive on the international market companies have to emphasise their uniqueness. Concentration on special features gives enterprises the chance to compete successfully. In this context the quality of companies is a significant criterion in comparison with other competitors. (Wank 2005b) The quality of enterprises is particularly determined by the quality of processes and the abilities, skills and knowledge of the people involved. Enterprises need a way to manage and optimise the processes and the competences of people. An approach to cover both fields and an example of its application will be presented in this paper.

Competences and their development

The word competence is ambiguous and complex. It is used in many different fields. Because of this there is no standard definition, nor is there a standard methodology. (Erpenbeck, von Rosenstiel 2003; Hartig, Maag-Merki, Klieme 2007) In most of the definitions the competences are subdivided into different categories. (Kaufhold 2006; Erpenbeck, von Rosenstiel 2003) In this paper competences are defined as all the abilities, skills and knowledge of a person. These are only revealed indirectly and can be assessed in performance and in results. Competences can be categorised into professional, methodological and personal competences. Professional competences are abilities, skills and knowledge connected with professional tasks. Methodological competences are abilities to independently develop solutions and learning skills. Personal competences refer to intrapersonal and interpersonal aspects. This means the person's self-image and his/her cooperation with other people. (Wank 2005a) Competences are not constant but variable. They depend

on situation, personal experience and motivation. This hints at the possibility to change and to develop competences. This process of development includes expanding, improving and refreshing competences. One single assessment of competences does not make sense and is not efficient. Only regular assessment offers the chance to get a realistic overall view and to track the development. (Kaufhold 2006) Training courses, self-organised learning and team-work are possibilities of developing competences. The acceptance and the support of the management are needed for the implementation of these possibilities. The management has to ensure the basic conditions to enhance learning.

The quality of companies depend on to processes and competences
According to DIN EN ISO 9000:2005 quality is defined as the "Degree to which a set of inherent characteristics fulfils requirements". This definition corresponds to the description "Degree of conformance between requirements and results" (Wank 2005b). Relating to the quality of enterprises a great many requirements of different stakeholders arise (Figure 2).
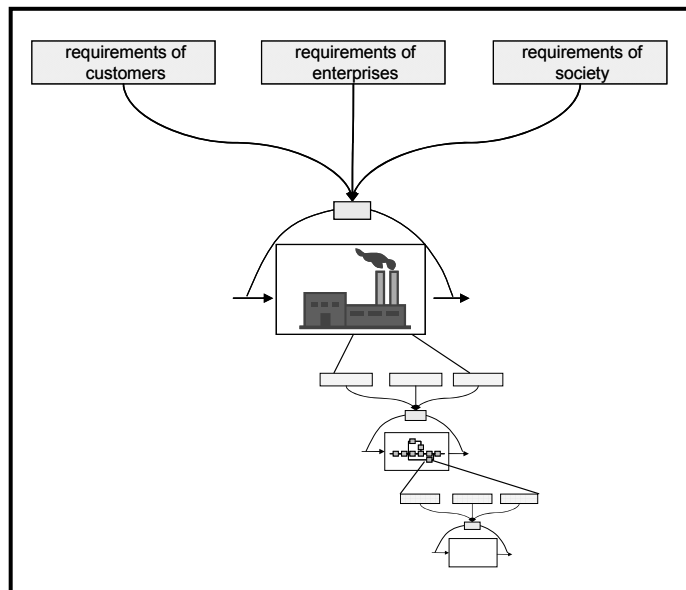
Figure 2: requirements on enterprises (based on Winzer 2002)

The requirements have to be met in each process and sub-process to improve the quality of enterprises. In terms of the process-oriented approach of DIN EN ISO 9000:2005 enterprises have to systematise their structure and optimise their operations. An effective design of processes has a fundamental effect on the quality of enterprises. Processes are defined as a "set of interrelated or interacting activities, which transforms inputs into outputs" (DIN EN ISO 9000:2005). According to the definition the outputs of a process depend on the interaction of inputs, person, working materials and operating resource (Figure 3) (Winzer 1997).

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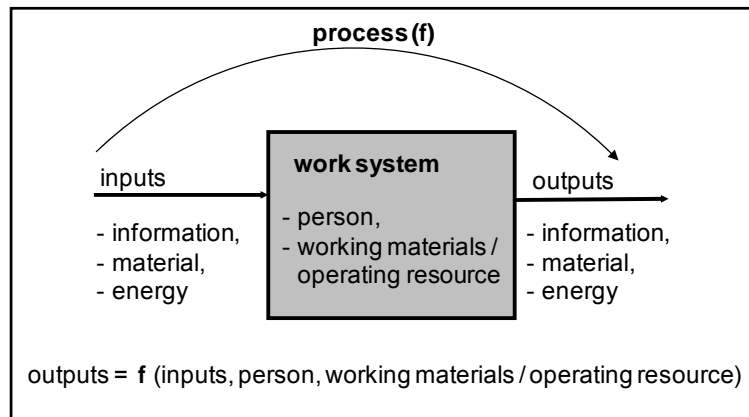Excellence; 20-22 August; 2008 in Helsingborg; Sweden

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Figure 3: definition of processes (Winzer 1997)

From the knowledge-based point of view the most important factor is the person with his competences. Certain competences are necessary to get results which meet the requirements. For each process a specific profile of the necessary competences is needed, because the necessary competences depend on the task, the working material and the necessary technology among other things. The attribution of these profiles to the processes provides enterprises with a process-oriented competence map (Figure 4).
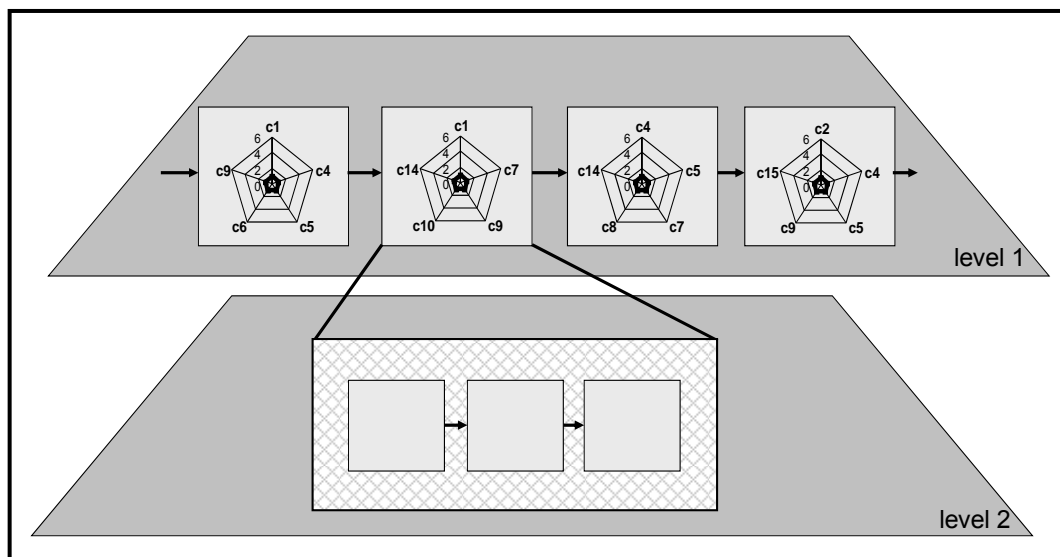
Figure 4: process-oriented competence map

The person needs the relevant competences to obtain results having the required quality. The necessary competences often change due to the dynamic of the requirements. The person has to adapt to these changes to perform his task in the right way. So independent learning becomes more and more relevant. (Bergmann, Pietrzyk 2000) But most of the persons do not know which competences are missing. They need an instrument to discover their shortcomings. By comparing the necessary competences with the existing competences of the people involved it is possible to identify shortcomings and potentials (Figure 5). If shortcomings are discovered, there will be different ways to react. By training courses, team work, changes in task it is possible to develop

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the competences according to the relevant aims. But not every competence of a person is needed in the relevant processes. In this way these potentials can be detected and maybe used for the company. (Wank 2005b)
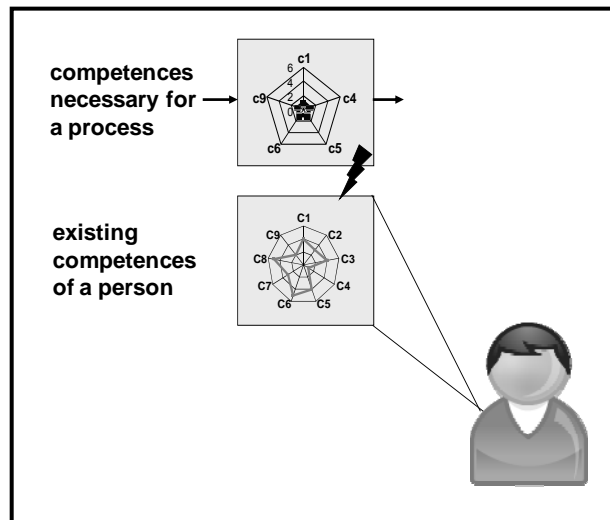

Figure 5: comparing competences (based on Wank 2005b)

Due to this companies need an overview of the processes and the personal and process competences. An efficient organisation of enterprises and a continuous development of the necessary competences are an important requirement to ensure survivability. This is an approach for managers to safeguard quality and to make strategic decisions. Companies need a method to assess the personal competences in connection with the necessary process competences. A lot of methods only assess personal competence, but this cannot solve the problems. Enterprises also need to assess process competences, which depend on the products and services.

Methodology
The methodology that we call "competence-circle" systematically prepares a completely process-oriented competence map (Figure 6). In four phases the user gets a process map, an overview of improvement potential in processes and recommendations for competence development. On the one hand this model assesses the competences needed for each process and the existing competences of each person. On the other hand the existing and the necessary conditions to enhance learning will be assessed. By comparing these profiles the enterprises can identify the potentials and shortcomings of competences, the improvement potential in processes and the improvement potential to enhance learning. Because of the variability of competences, regular application of the methodology and regular reprocessing of obtained data are important.

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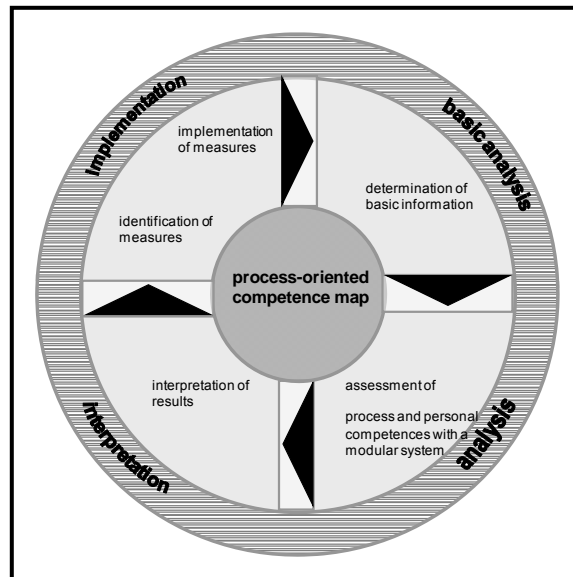Excellence; 20-22 August; 2008 in Helsingborg; Sweden

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Figure 6: competence-circle

The four phases: basic analysis, analysis, interpretation and implementation have to be applied in the way described below to obtain a useful process-oriented competence map. The basis of the assessment is the analysis of information relating to the company, the persons, the processes and the general conditions to enhance learning. This basic analysis describes the situation in enterprises and is important for the preparation of the next components.

The analysis of the process and personal competences is based on a modular system consisting of a basic and an advanced module (Figure 7). The basic module includes the analysis of the processes and of the competences. Moreover the existing and the necessary requirements to enhance learning will be analysed. The first step which is "analysis of processes" can be left out, if companies have already documented their processes. Based on the information of the processes the people involved will reveal the necessary competences of each process. In the next step the people involved will assess their competences themselves. After this basic module it is possible to compare the necessary and the existing competences and to identify potential areas of development. This assessment results in a quick survey of the competences without investing too much time. However, the results are rather one-sided and subjective. The application of the advanced module yields a more objective and comprehensive result due to the external assessment of the competences of the individuals involved. If both modules have been applied it is necessary to combine the results.
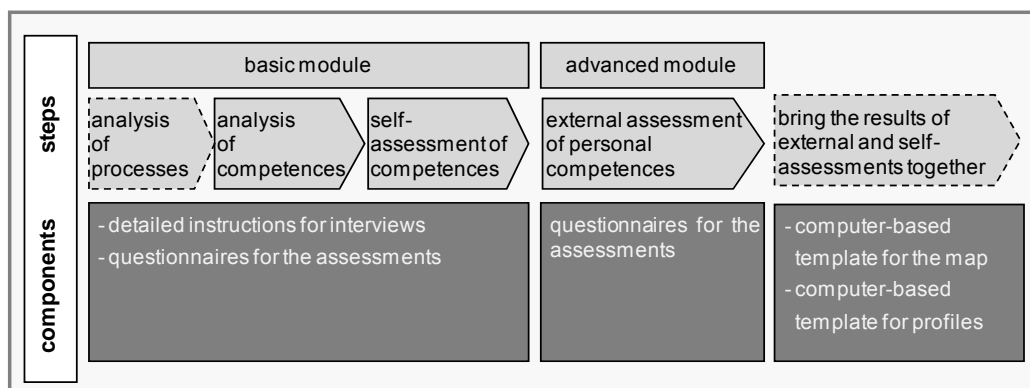

Figure 7: steps to analyse the processes and competences

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The results will be interpreted in the next phase. For each person the existing competences will be compared with the competences needed for the processes in which they are involved (Figure 8). So for each person the areas in which further development is needed are identified. Moreover, hidden potentials will be discovered. Besides, the existing and the necessary conditions to enhance learning will be compared.
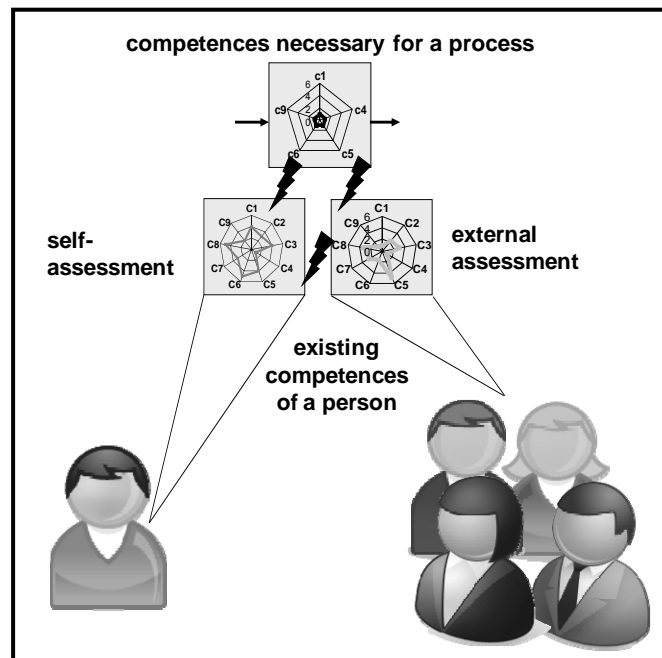

Figure 8: comparison of competences

Finally, in the last phase, appropriate measures will be identified and implemented. A catalogue of possible measures supports the choice. In individual talks with each person these measures will be discussed. If the persons agree to take action in this field they can decide what kind of measures they want to implement. By comparing the existing and the necessary conditions to support learning aspects for improvement can be found. Eventually, the management will be informed and can decide about what to do. There will be a checklist for the implementation and its control for each person and for the company.

The Tool

The methodology called "competence-circle" is supported by different components, like guidelines and questionnaires. For the analysis of the processes and the necessary competences the methodology uses individual interviews with open-ended questions, for which there will be instructions, and a catalogue of competences. To get relevant results of interviews it is necessary to create an atmosphere of mutual trust and transparency (Kaufhold 2006). Questionnaires are used for the self-assessment and the external assessment of the existing competences. The individuals have to assess themselves on a rating scale from 1 to 6. In the anonymous situation of filling in a questionnaire interviewees tend to answer more honestly (Kaufhold 2006).
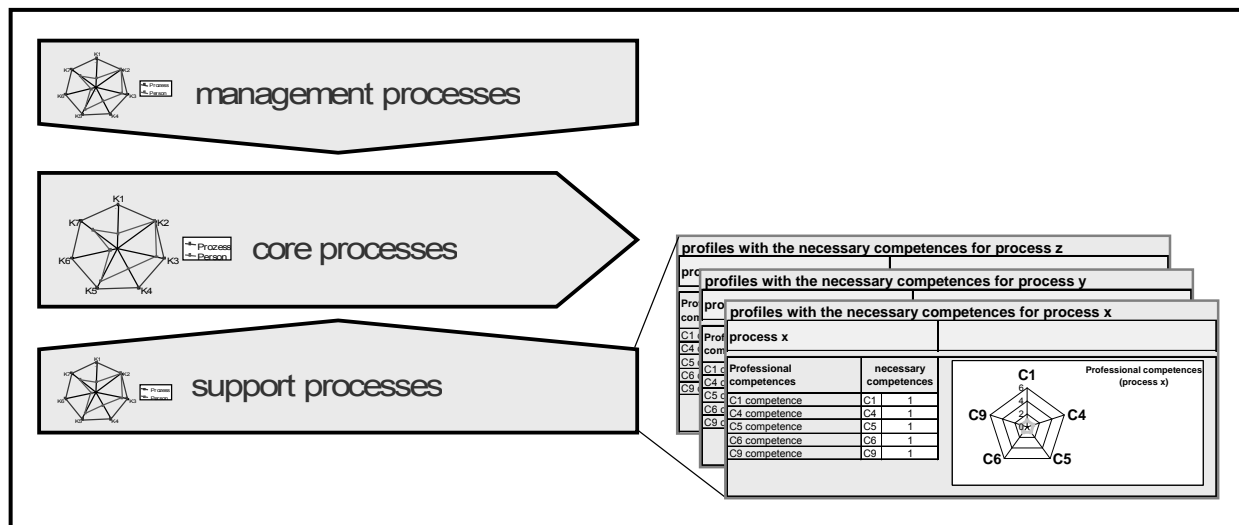
Figure 9: process-oriented competence map

The results of this assessment are
- a process-oriented competence map with profiles for every process revealing the necessary competences (Figure 9),
- a profile of the existing and necessary basic conditions to enhance learning and
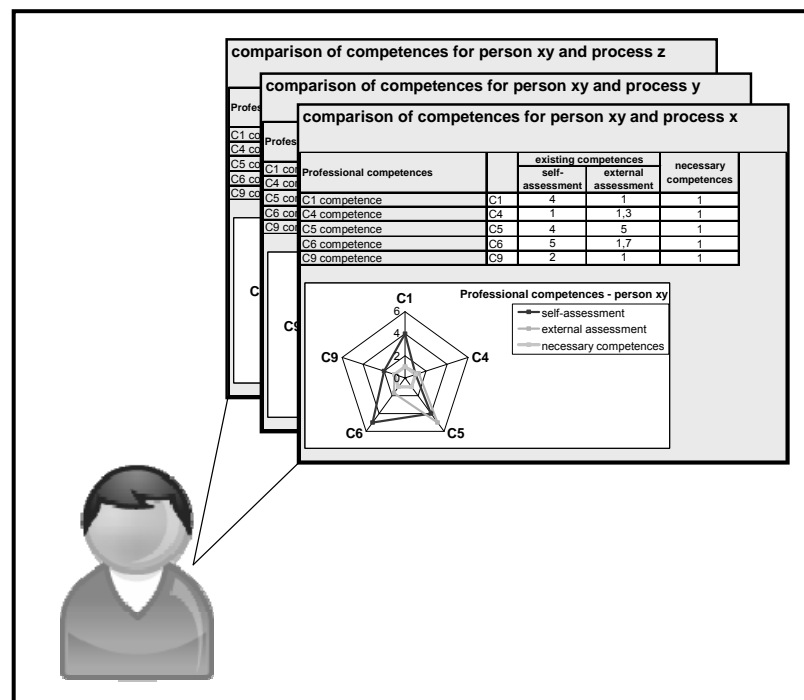- a folder with a survey of the existing and necessary competences for each person (Figure 10).

Figure 10: overview-folder for every person

Different tabulations in a clear arrangement indicate the
- potentials and shortcomings of each person,
- improvement potential to enhance learning,
- improvement potential in processes and

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- appropriate measures to develop competences.

These results aim to optimise the processes and to support the development of competences. Based on the measures that are taken the quality of enterprises will be improved. The identification of the shortcomings and the potentials helps to strengthen the core competences of enterprises. In this way enterprises can emphasise their uniqueness and compete successfully.

Results of the example

The "competence-circle" was tested in a small and medium enterprise, which operates in the industrial sector of management consulting. At present the enterprise has no quality management system and no documentation of processes. So an overview of the processes fails to be aware of improvement options. In the past different measures to enhance learning and to develop competences have already been suggested. But these suggestions were not directed to the necessary competences. So the measures were not goal-oriented and not adapted to the employees specific needs. To act more strategically information about the processes and the competences in the enterprise were missing.

The methodology was applied in the following way:
- In this enterprise the complete methodology was implemented. Because of the missing documentation it was necessary to also analyse the processes, besides the necessary competences. Therefore each person was interviewed individually about these aspects. The result was a process map with the appropriate competences.
- The persons assessed themselves by means of questionnaires. So an individual profile of competence was drafted for each person, which was compared with the appropriate processes. In this way potentials and fields in which further development was needed were identified. In individual talks measures were defined. The result was a folder for each person with the necessary and the existing competences and the plan of appropriate measures.
- After the self-assessment the enterprise decided to also implement the advanced module including external assessment. Thus the persons assessed one another. The comparison of the assessments was very interesting because the data were very different in some respects. This external view pointed at different potentials and fields of development.

The result of the practical application was the necessary overview of the processes and competences. The enterprise now has the information needed to improve processes and can purposefully support the employees' learning and studying. The knowledge about the necessary competences makes possible to deploy the employees goal-oriented. Moreover the knowledge about the potentials and shortcomings helps managers to make strategic decisions and to continuously improve the quality of the enterprise.

Outlook

The practical application has shown that the use of the methodology yields meaningful and important results to develop enterprises strategically. The methodology was tested successfully in a small enterprise. The applicability of the method in larger enterprises has to be tested in future. This concerns in particular the external assessment. In general the methodology is still rather difficult and too complex to be implemented for self-application. As the competences and the processes are not static, it is necessary to repeat the assessment regularly. Only in this way enterprises can monitor the competence development and the success of the measures. The possibility to apply the methodology on their own is one of the important requirements. This will in future be fulfilled by means of a computer program.

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Value innovation and a cognitive map of stakeholder-oriented quality management

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Abstract

Purpose – This paper discusses the influence and the contribution of value innovation on the existing quality management philosophy (paradigm) and principles which then be used for developing a cognitive map of stakeholder-oriented quality management.

Methodology/approach – The concept of value innovation suggests that "focus on stakeholders" is an implicit rethinking and reflection of "focus on customers", where creating radically attractive quality is aimed to satisfy and delight both existing and new customers, which eventually lead to the creation of value to shareholders and other business partners (stakeholder value creation). The EFQM business excellence model (which is described as a representation of quality management at a business level) is being used as a conceptualisation of stakeholder orientation. After modification and adaptation, the EFQM business excellence model is integrated with value innovation in order to develop a cognitive map of stakeholder-oriented quality management.

Findings – Value innovation implies that creative market exploration, future-pull orientation, and supply chain/network orientation should be included in the contemporary quality management principles. Based on the developed cognitive map of stakeholder-oriented quality management, stakeholder value creation requires integration between marketing and operations and is the result of managing properly the exogenous forces (e.g. market conditions and supply chain characteristics) and the endogenous forces (e.g. leadership, people, policy & strategy).

Research limitation/implication – The cognitive map of stakeholder-oriented quality management implies the needs for further research in quality management that integrate between marketing and operations as well as broaden the scope of quality management from a single company to supply chain/network.

Originality/value – This paper redefines/challenges some of the existing assumptions in quality management and offers insights regarding contemporary quality management perspective.

Keywords – Value innovation, stakeholder value, quality management, cognitive map, business excellence.

Paper type – Conceptual paper.

Introduction

Recently, the search toward a new quality management paradigm has, once again, become a "hot" topic (e.g. Zink, 2005; Conti, 2006; Mele and Colurcio, 2006; Zink, 2007). The *International Journal of Quality and Reliability Management* even dedicated a special issue (Vol. 24, No. 7): *Quality Management and Corporate Social Responsibility*, to build an understanding of stakeholder-oriented quality management paradigm (see Foster and Jonker (2007) in particular).

Williams et al (2006a) suggest that the challenge of new quality management will no longer be on reducing variation in the manufacturing, but on managing *market-related variation*

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(market changes), such as volatility of customers, volatility of price, etc. The focus on variation in the market may require us to deeply rethink and reflect on the *focus on customers* in TQM (that it is a generic term and mostly refer to existing customers). The TQM concept assumes that by focusing on customers, financial advantages can be gained through customer satisfaction and loyalty.

However, this assumption requires a further clarification in the sense that satisfying and retaining customers, as well as gaining financial advantages may require a radical transformation of doing business – *value innovation*, where continuous improvements (as generally prescribed by TQM in order to gain success) may no longer be enough. Value innovation focuses on satisfying not just existing customers but also delighting new customers in "newly created" markets. Here, innovation is not defined narrowly as product/service innovation, but broadly as the way of doing business (in which the product/service is offered). This means that innovation may also occur at a "higher" (business) level in order to "match" between *what is offered* and *the way it is offered*.

In order to satisfy and delight customers through value innovation, an organisation needs to collaborate with other actors in the supply chain/network because an organisation may not have certain external resources (owned by other firms) and competencies which are important (required) for value innovation. Consequently, *focus on customers* should give "pay-off" to, not only, the organisation (shareholders) but also other actors in the supply chain. Hence, it may be clear that *focus on stakeholders* should actually be "built-in" in the *focus on customers*.

The "essence" of value innovation can be described as creating *stakeholder value* through *radical (disruptive)-attractive quality*. If Lilja and Wiklund (2006) describe the obstacles (hinders) for the development of practices of attractive quality creation, *value innovation* (e.g. Kim and Mauborgne, 1997; Matthyssens et al, 2006), which is also known as *strategic innovation* (Markides, 1997; Schlegelmilch et al, 2003) or *business-model innovation* (Markides, 2006) may provide insights or explanations regarding the *enablers* (*facilitators*) of attractive quality creation that may delight customers and create value for other stakeholders. Therefore, the purpose of this paper is to discuss the contribution of value innovation in building a *cognitive map* of stakeholder-oriented quality management, although the term "stakeholders" mainly includes customers, the organisation and its partners.

Value innovation
Together with *radical product innovation* and *disruptive technological innovation*, *value innovation* is categorised as *disruptive innovations* (Markides, 2006). Value innovation is different to technological innovation (Kim and Mauborgne, 1999a). The focus of value innovation is not on technological aspects, but rather on the reconceptualisation of the industry/business model (or "breaking" the rules of the "game") in order to create fundamentally new and superior customer value, where successful value innovation are embedded in a company's entire network of relationship, i.e. company's suppliers and other network partners (Matthyssens, 2006).

The logic behind value innovation is to provide a package (total solution), extraordinary experiences, while reducing cost for the company, in which there are three platforms where value innovation can take place: product, service, and delivery (Kim and Mauborgne, 1997). Value innovation is the result of a combination between *eliminating*, *reducing*, *enhancing*, and *newly creating* key elements of product, service and delivery (Kim and Mouborgne,

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1999b). Therefore, Value Analysis/Engineering is a useful method in the attempts of eliminating and reducing the features, while enhancing and creating new key elements are common activities in the product/service design and development processes.

According to Schlegelmilch et al (2006), strategic (or value) innovation is driven by culture, processes, people, and resources, and it contains three elements: 1) fundamental reconceptualisation of the business model, 2) reshaping of existing markets, and 3) dramatic value improvements for customers.

Value innovation is neither about striving to outperform competition nor about segmenting markets and accommodating customers' individual needs and differences (Kim and Mauborgne, 1999a). It is about making the competition irrelevant and creating new markets (Kim and Mouborgne, 1997, 1999b) to delight the existing customers and attracting new ones (i.e. mass market) by finding the shared common/sought values. Consequently, it is important to identify the values (in a non-competition context) that are *critical for customers* as well as finding the critical product (or quality) attributes that are critical for creating those values (Setijono, 2007).

In order to create barriers for the imitators, value innovators may need to "cut" the cost in order to maximise profits (shareholder value) by e.g. strategic pricing, target costing, business line extensions, and continuous improvements before another value innovation is launched (Kim and Mauborgne, 1999a).

Knowledge and ideas are the input of value innovation (Kim and Mauborgne, 1999a), thus the capability to create value innovation is related to the concepts of *absorptive capacity* (i.e. the ability to recognise the value of new information, assimilate it, and apply it to commercial ends) and *dynamic capabilities* (i.e. the firm's processes that use resources to match and even create change) (Matthyssens et al, 2006).

Value innovators are "*…characterised by cultures that promote experimentation and risk taking, loose and decentralised structure with limited hierarchy...*" (Markides, 2004; p. 37). This description is very similar to the culture practised by Toyota Production System, where changes or improvements are seen as experimentation and facilitated by limited hierarchy between leaders and employees (see Spear and Bowen, 1999; Spear, 2004). Therefore, *Lean Thinking* may be a part of the underlying "spirit" or philosophy behind value innovation. Womack and Jones (1996) describe that value to customers should be expressed in terms of specific product *capabilities*, at a specific *time* and *price*. However, the primary focus of applying Lean Thinking has been on creating or delivering at a specific time and price, not much on the specific capabilities that customers are looking for. Realising this "gap", Womack and Jones (2005) introduce *Lean Solution* in order to ensure that customers' problems are solved "completely" without hassle by taking into account customers' experiences when shaping/improving the processes. Activities that cause customers' irritation are simplified, reduced, or eliminated, which eventually lead to time and cost advantages. Therefore, Lean Solution seems to be an important part of value innovation in the sense that it is an approach to continuously improve value once value innovation has been created.

Value innovation: the impacts on quality management
Value innovation is considered as a high-priority research in innovation that integrates (interfaces) marketing and operations (Karniouchina et al, 2006). Therefore, the future quality management paradigm will likely be featured by integration between marketing and

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operations. Since value innovation is at a business level then we need to find a similar level of analysis to represent quality management when discussing the impact of value innovation on quality management. In this case, the EFQM business excellence model may be used as an appropriate approach for such analysis. However, it should be noted that the focus should not be on competition (i.e. being the best). Therefore, the EFQM business excellence model can be an inspiration to build a cognitive map of stakeholder-oriented quality management based on value innovation.

Value innovation may require a new insight on *market orientation* and/or *customer focus*, meaning that being market-oriented is not just about fulfilling customers' existing needs (*pull*), but also about using creativity and knowledge to offer new solutions. The proactiveness in offering new solutions makes value innovation as if it is *push-oriented* although it actually has a *future-pull orientation* (Krinsky and Jenkins, 1997), i.e. solutions that are derived from the future (or latent) needs, as the result of a creative exploration process. Therefore, value innovation is not only about satisfying and delighting the existing customers but also new customers in newly created markets. This means that *creative market exploration* and *future-pull orientation* should be some of the contemporary quality management principles.

Considering the fact that value innovation should be embedded in a network of relationships, then the effort and the perspective of managing quality should be broadened from a single company to a supply chain (or network) perspective.

Discussing the implications of value innovation on quality management "elevates" the stakeholder orientation issue. The stakeholder orientation is not new in quality management, although it recently gains more attention again in the quality management literature. The following section compares two approaches in explaining the concept of *stakeholder orientation*.

Stakeholder orientation: is business excellence model a relevant approach?
Balanced scorecard (figure 1) is usually used to accommodate the stakeholder perspective by translating vision and strategy into measurements related to *financial*, *customers*, *internal process*, and *learning and innovation* (Kaplan and Norton, 1992; 1996; 2007).
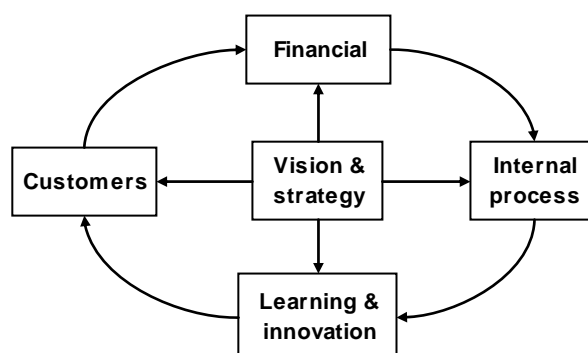

Figure 1. Balanced scorecard

Comparing balanced scorecard and the EFQM business excellence model (figure 2), it can be seen that these two methods is structurally similar in the sense that we can find symmetry

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(equivalence) of the components in one model to another (see table I). *Key performance results* can be stated in, for example, in *financial* term. The *customers* include not only the *external customers*, but also internal customers (*people*) and the *society*. The *process* can be defined as *internal process*. *Learning and growth* is a function of *leadership, partnership & resources, policy & strategy*, and *people*.
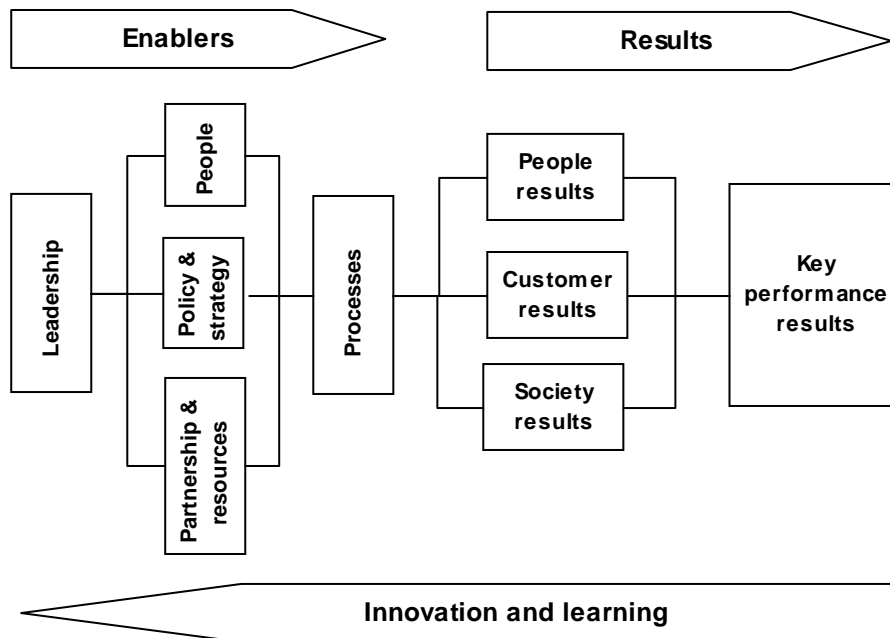

Figure 2. EFQM Business Excellence Model

Table I. Symmetry (equivalence) between balanced scorecard and business excellence model

Balanced scorecard	Business excellence model
Financial	Key performance results
Customers	Customer result [incl. people results and society results]
Internal process	Process
Learning and innovation	Leadership; partnership & resources; policy & strategy; people

The main advantage of balanced scorecard is that it is linked to vision and strategy (an important aspect in value innovation) although the components are not exactly specified. The EFQM business excellence model, on the other hand, provides a more detail description, although it: 1) is not directly linked to vision and strategy, 2) focuses on being the best (except when it is used as a self-assessment tool), and 3) innovation and learning is a feedback mechanism in the model, not a component of the model (unless we refer to the *EFQM framework for innovation*).

Since our focus here is on stakeholder-oriented quality management, then it will be appropriate to use the EFQM business excellence model to represent the focus of quality management on stakeholders. Using the EFQM business excellence model to build a cognitive map of stakeholder-oriented quality management requires a revisit and an adjustment on business excellence model. In fact, the EFQM business excellence model has

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been critically reviewed by, e.g. Williams et al (2006b) and Kim and Mauborgne (2005), where one of the criticisms was that excellent business is not enough for survival in the market.

Cognitive map of stakeholder-oriented quality management: inspiration from the EFQM business excellence model

Based on Spicer's (1998) presentation about different definitions and description of *cognitive maps* (in the field of organisational learning) by different researchers, a cognitive map is:

A graphic (picture or visual) representation of a set of *discursive* (i.e. ranging over a wide field; utilising or based on analytical reasoning contrasted with intuitive) representations made by a subject with regard to an object in the context of a particular interaction. It provides graphical description of the unique ways in which individuals view a particular domain (field of thought or action). Hence, a cognitive map represents individual's *idiosyncratic* (personal; peculiar to individual) perception of reality.

The cognitive map of stakeholder-oriented quality management (figure 3) consists of three parts: *enablers*, *value innovation*, and *results* (*stakeholder value*).
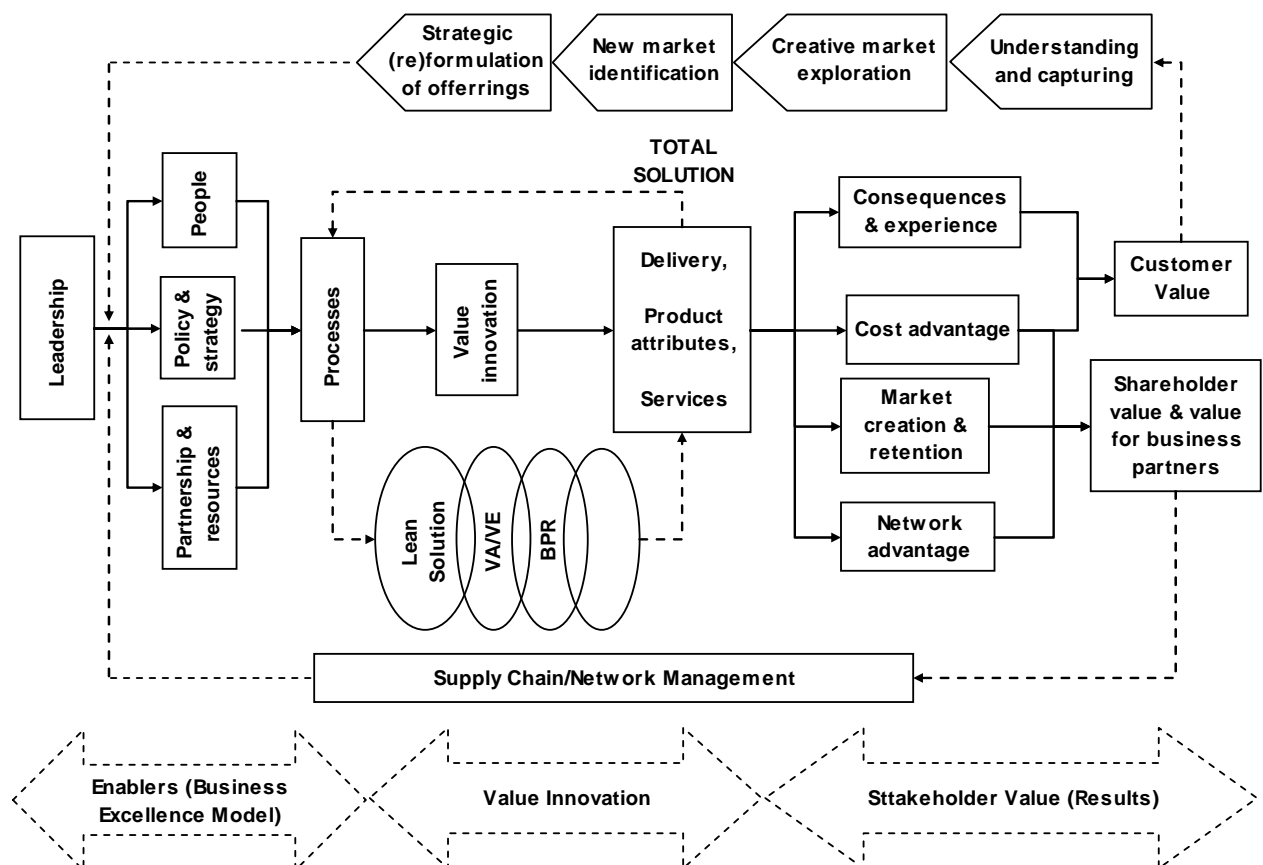

Figure 3. A cognitive map of stakeholder-oriented quality management based on business excellence model

The first part is the *enablers* of stakeholder value creation, which is directly adopted from the *enablers* in the EFQM business excellence model because the drivers of value innovation (i.e.

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culture, process, people, and resources) are essentially the same as the enablers of the EFQM business excellence model.

The second part, *value innovation,* emphasises the necessity of *total solution* when creating stakeholder value. It can be argued that value innovation is a part of the *enablers*. Value innovation (as well as other types of innovation) can be described in terms of certain paths/flows to follow that we may call as process (which is why value innovation is a part of the *process*), but value innovation also involves redefinition/reflections (i.e. strategic business reformulation by management and supported by leadership) that may be too complicated to be described simply as a process (which is why value innovation may even be included in the other elements of the *enablers*). In figure 3, value innovation is placed after the *process* in order to make it obvious that value innovation represents the creative changes in the process that lead to the launch/delivery of new offerings to the market. Changes do occur in the process but not all of them are feasibly/successfully creating "something" new to be launched in the market.

It should be noted that, once created, value innovation needs continuous improvements in order to achieve operational excellence ("perfection") and to maximise shareholder value. *Lean Solution* (Womack & Jones, 2005) intends to provide total solution that "completely" solves customers' problem by managing business processes. Therefore, it is suggested that Lean solution could be used to complement value innovation by continuously improving the created value. Other methods/tools such as Value Analysis/Engineering and Business Process Reengineering may also be useful for striving towards "perfection". This part of the map explains the *endogenous* force for creating stakeholder value.

The third part of the model is the *results*, i.e. creating value for stakeholders (customers, shareholders, and business partners), in which value creation can be specified in terms of consequences/experience for customers, cost advantage, market creation and retention, and network advantage.

The map (figure 3) suggests that customer value (through a series of *understanding and capturing customer value*, *creative market exploration*, *new market identification*, and *strategic (re)formulation of offerings*) and value to other stakeholders (through the management of supply chain/network) "inspire" organisational *policy & strategy*, as well as the way of managing *people* and *partnership & resources*, which is further deployed to the *process* and becomes the source of value innovation. This part of the map explains the *exogenous* force for stakeholder value creation.

Conclusion
Value innovation plays an important role in creating [radically] attractive quality for customers and at the same time creating value for other stakeholders. Therefore, value innovation is an important part of a cognitive map of stakeholder-oriented quality management. Since value innovation is at a business level, developing the cognitive map of stakeholder-oriented quality management should adapt quality management at a business level, e.g. the EFQM business excellence model. The cognitive map of stakeholder-oriented quality management, inspired by the EFQM business excellence model, consists of three parts: enablers, value innovation, and stakeholder value (results). Here, value innovation is the link between the enablers and the results of stakeholder value.

The cognitive map of stakeholder-oriented quality management indicates that creating stakeholder value requires both *endogenous* and *exogenous* forces. Endogenous forces are generated by internal factors in the organisation such as leadership, policy & strategy, and people. Meanwhile, exogenous forces are external factors outside the organisation, for example: customer value, market conditions, and supply chain/network characteristics. Hence, organisation's ability for being value innovative (and thus creating value for its stakeholders) depends on the ability to manage these forces.

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Further readings
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Quality Management Systems as a Support for Value Creation

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Abstract

Purpose: To explore the role of a quality management system (QMS) for the assurance and improvement of value in an inter-organisational business relationship. The study was carried out in the public transportation industry, where service production has been outsourced.

Methodology/approach: In-depth interviews were conducted with 26 participants from two organisations involved in an inter-organisational business relationship. From the interview material we identified what creates value in the inter-organisational business relationship and for the passengers of public transportation. All value drivers were categorised according to the central areas in a QMS.

Findings: The results show that internal processes and management responsibility are central areas where value is destroyed. Since service production has been outsourced, this means that the intended value is never experienced by the passenger.

Research limitations/implications: The value creators and destroyers identified originate from the suppliers' view and focus on how the different suppliers together create value for public transportation passengers.

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Practical implications: Managers should acquire knowledge regarding the value they create or destroy and focus on improving the value creation process. The QMS can be used to assure and improve value creation in an inter-organisational business relationship.

Originality/value: Our research contributes to shedding light on the difficulties and possibilities in value creation where service production has been outsourced.

Keywords: Value creation, Quality Management Systems, Public transportation

Paper type: Research paper

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INTRODUCTION

Outsourcing service processes and establishing inter-organisational relationships have become an increasingly used business strategy in many industries (Metters and Verma, 2007). Such organisational settings can be challenging to manage, as the more actors that conduct various activities and have different roles and objectives, the higher the complexity within these networks (Normann and Ramirez, 1993). Creating value to customers is a concern to all kinds of businesses. Research shows that value is the primary influence on purchase decisions and the leading indicator of market share, revenue growth, profitability, and competitive advantage (Monroe, 2003). Being able to create value for the customer in a context where the service production process has been outsourced requires a high degree of co-ordination and shared visions between the different actors.

A context where service production has been outsourced is the public transportation industry in Sweden. Each county has a Public Transport Authority (PTA), responsible for public transportation in the region on roads and railway as well as public transport from and to the region. The transports are run by private operators and the business relationship is regulated through a contractual governance agreement. These organisations, the PTA and the operators, jointly create value for their common customers (Enquist, 1999; Enquist et al., 2005). The PTAs do not have a direct, face-to-face, relationship with the users of public transportation, and there is thus a mutual dependence between the PTA and the operators in delivering value-creating services. For a business-to-business relationship like the one described, where the service production has been outsourced, to improve the value creation, i.e. increase the benefits and decrease the sacrifices, knowledge must first be acquired concerning the value they create, or destroy.

The creation of value for stakeholders in business networks can be managed in different ways. One possible strategy is to design and develop a quality management system (QMS), which can be viewed as a management system to direct and control an organisation with regard to quality. A QMS can be designed to include certain principles, additional practices and techniques (Dean and Bowen, 1994). It often follows the substance of Deming's PDCA cycle (Deming, 1986), and provides support to organisations for the assurance and improvement of quality. Within an organisation, or business network, there are internal processes whose aim is to manage and support the operative processes. To create value in an inter-organisational relationship, a joint quality management system is needed with shared resources to perform the processes and shared routines to measure and improve them.

The aim of this paper is to explore the role of a quality management system for the assurance and improvement of value in an inter-organisational business relationship in the public transportation industry, where service production has been outsourced. The study focuses on an inter-organisational business relationship between a PTA and a private operator. The empirical research is based on 26 in-depth, semi-structured interviews with managers and employees from these two organisations, whose purpose was to identify value drivers, i.e. the attributes that create or destroy value. The research results are analysed with central concepts of a quality management system. The findings show that multiple value destroyers relate to internal processes within this business network, which negatively affect efficiency. Furthermore, several value destroyers could be traced to the concept 'management responsibility' within this inter-organisational relationship. These results illustrate that

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internal processes and management issues are central areas that destroy value in a context where service production has been outsourced.

THE VALUE CONCEPT

Value has been discussed in a variety of literature streams and has a range of different meanings assigned to it (Gale, 1997). Many scholars define value as a trade-off between benefits and sacrifices perceived by the customer in a supplier's offering (Zeithaml et al., 1990; Monroe, 2003; Woodruff and Gardial, 1996). The perceived benefits are a set of physical attributes, service attributes and technical support available in relation to the particular use situation, and the perceived sacrifices are sometimes referred to the price but can also be described more broadly (Monroe, 2003). Customer value theory stresses the importance of understanding customer perceptions of value (Woodruff, 1997). However, suppliers also need to understand how they can create and deliver value in business-to-business relationships beyond merely selling products (Ulaga and Eggert, 2006), as value is created, originally owned and offered for sale by a seller, independent of customers' perception (Holbrook, 1994).

Value as constellations of value creators and destroyers

The relational exchange of value, i.e. value as embedded in the relationship between business partners, and further constellating value drivers, has been investigated by some scholars, see e.g. Anderson et al. (1993), Anderson and Narus (1995; 1999), Lapierre (1997; 2000), Ulaga (2003), Ulaga and Eggert (2006), Vargo and Lusch (2004), Lusch and Vargo (2006), Walter et al. (2003). An investigation of the constellation of value, i.e. benefits and sacrifices, conducted by Lapierre (2000) focused on a business-to-business domain in the service sector and identified 13 value-based drivers of customer-perceived value. The 13 value drivers were divided into three scopes: product, service and relationship. The perceived benefits, which include ten value drivers, refer to the product (alternative solutions, product quality, product customisation), service (responsiveness, flexibility, reliability, technical competence) and relationship (image, trust, solidarity). The perceived sacrifices, which include three value drivers, refer to price, time/effort/energy and conflict issues.

Value creation in business networks

An organisation can create value in three domains: value creation through relationships with suppliers, i.e. in a business-to-business domain, value creation through alliance partnering, and value creation through relationships with customers, i.e. in a business- to-consumer domain (Ulaga and Chacour, 2001). Many industries are establishing inter-organisational relationships through the outsourcing of parts or their total offerings, which forces a rethinking concerning organisational structures and managerial arrangements (Ramirez, 1999). Within these business networks, organisations together produce value through their relationships, partnering and alliances. The value concept represents a view that value is created by various actors using various resources in the market or business network (Ramirez, 1999). This means that values are co-invented, combined and reconciled in an interlinked chain of activities (Porter, 1985). The actors in these networks can be separate or joint economic actors. For this reason, value creation can be studied in joint ventures or separately. The complexity and dynamism of roles and relationships is increasing in joint business systems (Normann and Ramirez, 1993).

QUALITY MANAGEMENT SYSTEM

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A Quality Management System (QMS) can be viewed in different ways. ISO defines it as a "management system to direct and control an organisation with regard to quality" (ISO 2000a). Berggren et al. (2001) give a more comprehensive description and view it as a tool to control and improve the quality of the organisation's products, which includes everything from methods and routines to organisation and responsibility distribution.

The authors of this paper interpret a QMS as a comprehensive practice which supports the assurance and improvement of quality (ISO, 2000b, c). In this interpretation of QMS, commonly recognised principles and techniques described by authors such as Dean and Bowen (1994) are used to customise practices to fit the needs of a particular organisation. It is of further interpretation that every organisation has a general management system whose development can be graded on a scale according to different levels of adoption. In regard to the higher levels, organisations have achieved efficiency and effectiveness through continuous improvement and learning.

The purpose of a QMS is to establish an organisation's policies and to realise the contents of these policies through short and long term goals (Nilsson, 2000). The substance of a QMS often follows the PDCA cycle (Plan-Do-Check-Act) (also known as the PDSA cycle, Plan-Do-Study-Act). The cycle is a continuous quality improvement model consisting of a logical sequence of four repetitive steps for continuous improvement and learning (Deming, 1986). The main purpose is to start by planning and formulating concrete goals for the organisation. The next step is to put the action plans or programs into action to reach the goals, check that the goals have been obtained and then evaluate and further improve the organisation's processes (ISO, 2000b, c).

A quality management system can be developed according to a standard, where ISO 9000 is the best known standard (Nilsson, 2000). The ISO 9000 series of quality management systems standards is a widely diffused management technique, i.e. the ISO 9001:2000 standard has been adopted by over 897 000 facilities in 170 countries (ISO, 2006). The standard ISO 9000 consists of specified requirements for a quality management system. All requirements of ISO 9000 are generic and are intended to be applicable to all organisations, regardless of type, size and product provided (ISO, 2000b).

The requirements of ISO 9001:2000 are divided into five areas: Quality management system, Management responsibility, Resource management, Product realisation, and Measurement, analysis and improvement (ISO, 2000b). The model of a process-based quality management system, shown in Figure 1, illustrates the process linkages between the five areas, and shows that customers play a significant role in defining requirements as inputs. Monitoring customer satisfaction requires an evaluation of information relating to customer perception as to whether the organisation has met the customer requirements. The model covers all the requirements of ISO 9001:2000 but does not show processes at a detailed level (ISO, 2000b). The full arrow in the figure symbolises value-adding activities and the broken line stands for information flow.
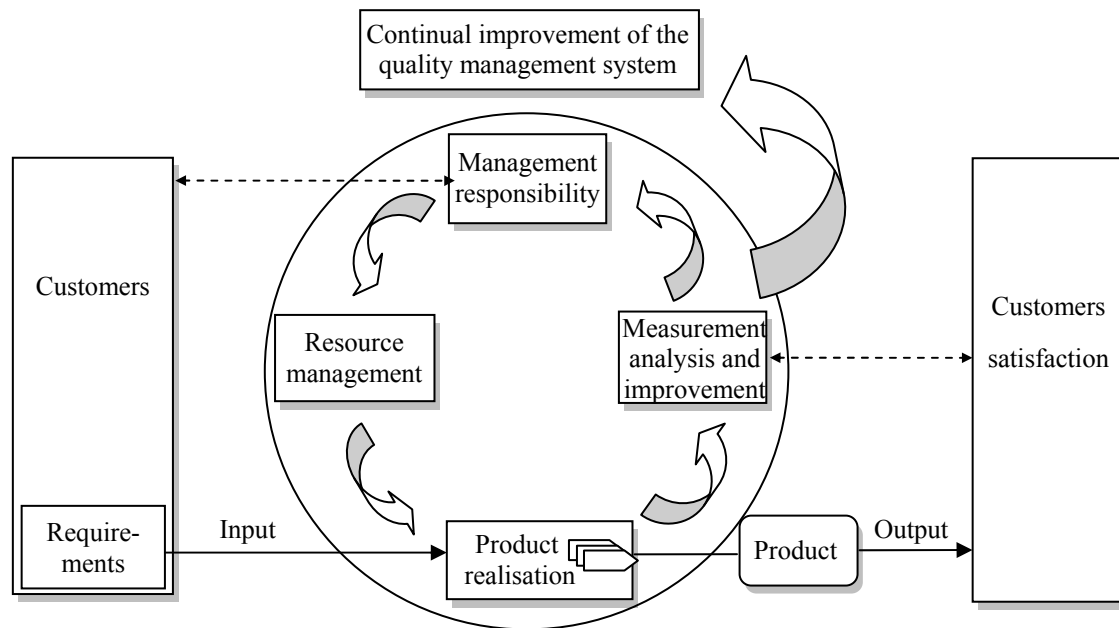
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Figure 1 Process approach of the QMS. Reproduced from ISO 9004:2000

EMPIRICAL INVESTIGATION

Public transportation in Sweden has undergone a transformation in recent decades to being organised, as regulated by law, with a Public Transportation Authority (PTA) in each county. The PTAs manage the public transport while the services are outsourced and provided by private-owned operators that are contracted through a public procurement process. The PTAs are responsible for public transportation in the region on roads and railway as well as public transport from and to the region. The owners of the PTA are the county council and the municipalities. The owners, the PTA and the operators form a business network with a joint interface towards their common customers. The activities within these networks, which are coordinated by the PTAs, have developed a practice based on contractual governance and management accounting/control (Enquist, 1999; Enquist et al., 2005). This has according to Enquist et al. (2005) led to the operators becoming production-oriented with a focus on cost rationalisation, which has resulted in a reduction in services.

Sample

Data were gathered in in-depth interviews with 26 managers and employees at both a PTA in Sweden and at their largest operator, which runs approximately 71 % (in 2008) of the total transports in this county. The participants were both influential decision-makers in this relationship and employees with a business relationship with the PTA/operator. This background was critical to the process of identifying and describing value-creating drivers. At the PTA, there were a total of seven managers and all interviewed. An additional six employees were identified at the PTA as having a relationship with this particular operator. At the operator, six managers and a further seven employees participated in the study.

Interview guide

The interview consisted of three parts. In the first part the interviewee described the research project and the value concept and the respondents were asked about their own backgrounds and their positions in the company. In the second part the respondents were asked to describe

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what benefits and sacrifices they perceive in relation to the customers and then in relation to the PTA/operator. The respondents were asked to describe the value drivers and which effect they had. In the third part the participants were asked if they could identify some critical incidents, positive or negative, that had occurred and that influenced the relationship. The notion of incidents traditionally refers to an episode when the customer interacts with the service provider's contact persons, systems, or physical equipment. In contrast to routine incidents, a critical incident (Bitner, 1990; Flanagan, 1954; Johnston, 1995) or critical phase (Edvardsson and Strandvik, 2000) is when something happens, unusually positive or negative, which deviates from the normal and catches attention (Edvardsson and Olsson, 1992). Critical incidents influence the relationship, e.g. a negative critical incident may result in the termination of a relationship and a positive critical incident may result in a stronger and deeper relationship. They were asked to give a detailed description of the incident: its cause, course and finally what the result of the incident was.

The value drivers were analysed and categorised according to the areas of the QMS standard ISO 9001:2000: Quality Management System, Management responsibility, Resource management and Product realisation, Measurement, analysis and improvement.

RESULTS AND ANALYSIS

By using the 'critical incidents' technique (Edvardsson, 2000) and investigating the relationship dynamics between a PTA and their largest operator, areas of improvement were identified in their joint management system and, further, conflicts concerning their individual management systems became apparent. In 2005, the operator in question had financial problems and was forced to cut costs by optimising the traffic. Practically, this meant that each vehicle was heavily used. The spare vehicles that the PTA had paid for through their contractual agreement were never utilised. The production, that is, the quantity in kilometres which each vehicle runs, became the operator's foremost priority and the service to the customers deteriorated. There were severe problems with traffic delays and customers complained through the local newspaper, to the operator and to the PTA. As the PTA is responsible for the traffic, it was forced to deal with the problematic situation. The PTA made the decision to publicly blame the operator for the traffic delays, which put a strain on the business relationship between the two actors. An additional factor that caused the relationship conditions to become critical was the contractual agreement which was established and became valid in 2004. The requirements in the agreement are formulated in a way that makes it possible for the operator to interpret its contents, e.g. instead of formulating the requirement regarding the cleaning of vehicles more explicitly, "the vehicles must be cleaned inside and out on a daily basis", it is formulated rather ambiguously, "the vehicles must be clean and intact". The operator, with its financial difficulties, utilised this vague agreement to its own advantage, which deteriorated the service quality for the customers. These critical incidents, i.e. the operator's optimising of traffic and interpretation of the contractual agreement to its self-interest, illustrate how value can be destroyed in an outsourced service production context.

From the interviews, value drivers were identified, analysed and sorted with respect to a business to customer perspective and a business-to-business perspective.

The business to customer domain

Altogether 67 value drivers were identified in relation to the business-to-customer domain. The analysis revealed 35 benefits and 32 sacrifices. In relation to the central areas of a quality

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management system, Management responsibility revealed seven benefits and 14 sacrifices, Resource management revealed one sacrifice, Product realisation revealed 25 benefits and three sacrifices, and Measurement, analysis and improvement revealed three benefits and 14 sacrifices, see Figure 2.

The analysis shows that several attributes that create value can be traced to 'Product realisation', with examples such as 'vehicle quality', which the participants perceive as being improved as a result of the latest contractual agreement. 'Adjustment of traffic' was also perceived as a driver that creates value, i.e. major restructurings had been carried out in recent years by the PTA to make the traffic agree better with the travelling patterns of today's users of public transportation.

Regarding the drivers that destroy value in relation to the customers, the analysis shows that the greatest number of value destroyers was related to 'Management responsibility'. According to the PTA, the relationship between the PTA and the customers can be improved. The PTA perceives it as challenging to manage this business network without having direct face-to-face contact with their consumers. The relationship deficiencies between the PTA and operator affect their common customers, as the operator's actions and attitudes towards them are influenced by the relationship with the PTA.

Certain prerequisites mentioned by the respondents can also be traced to the area 'Management responsibility'. These prerequisites are issues that are outside the control of any of the actors' value creation network but can be viewed as belonging to the system. Examples of such prerequisites are e.g. the latest governance agreement from 2004 that contains a number of deficiencies, such as 'breaches of agreement' and 'indistinct agreement'. Other examples of prerequisites are the 'public procurement process' and 'different regulations'. The 'physical location of the PTA's main office also causes a geographical distance to the customers'. Further, the industry suffers from a 'culture of low price and low quality' and the 'level of educational attainment' is low. These prerequisites influence the possibility to create value for the users of public transportation. Although they are outside the day-to-day activities of the value-creating network, they still belong to 'Management responsibility', as it is their obligation to analyse these prerequisites and plan for how to reduce them as they hinder the value creation processes.

In relation to the business-to-customer perspective, the most frequently mentioned value creator is 'Adjustments of traffic', which can be derived to 'Product realisation', and the most frequently mentioned value destroyer in the same domain is 'Vehicle quality' within 'Measurement, analysis and improvement'. Even though it is the perception of the respondents that the quality of vehicles has been improved since the latest contractual agreement was established in 2004, many still perceive the quality as deficient and in need of further improvement, see Figure 2.
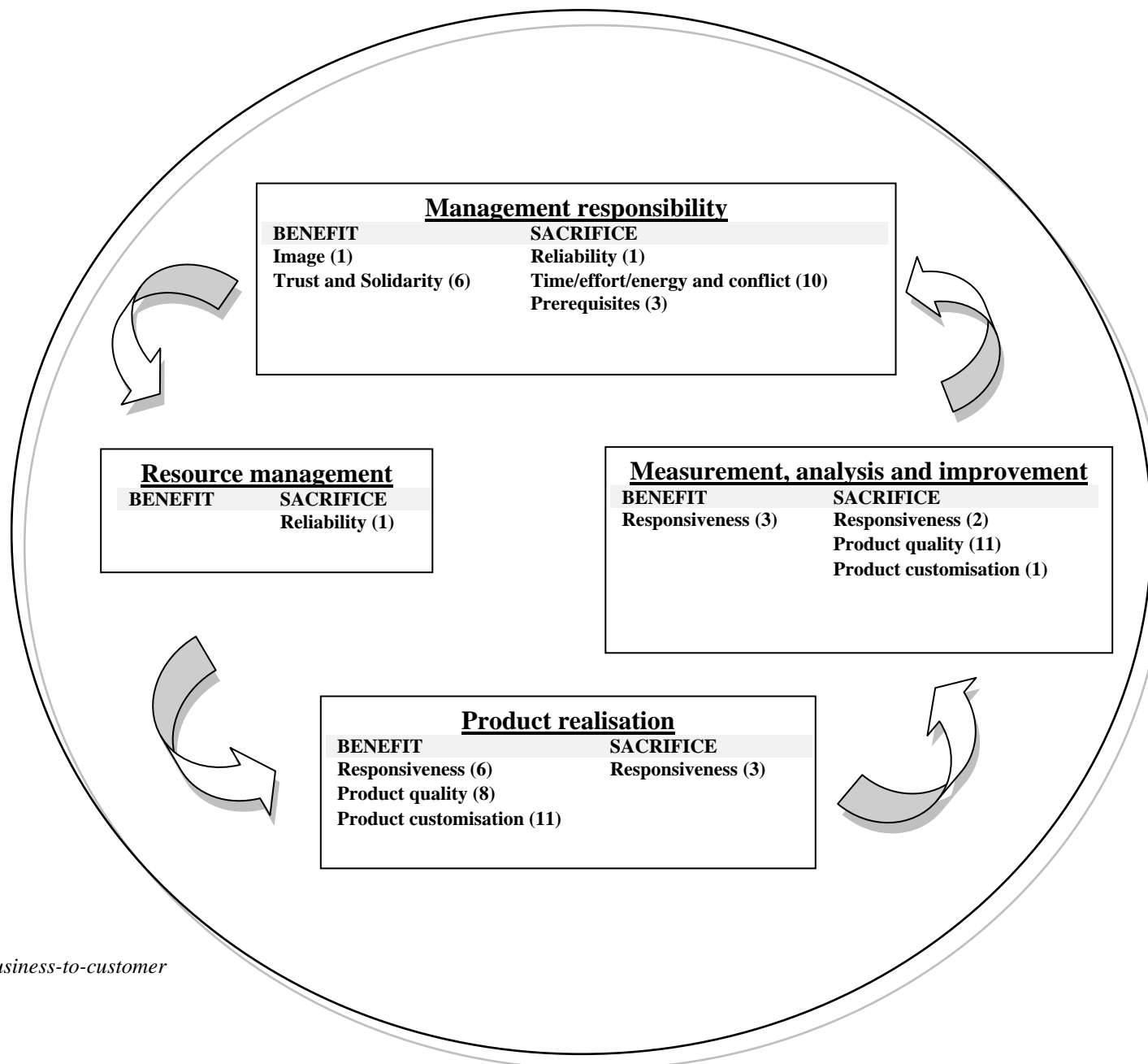
Figure 2 Domain: business-to-customer

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The business-to-business domain

Altogether 204 value drivers in the business-to-business domain were revealed: 41 benefits and 163 sacrifices. The analysis revealed 41 benefits and 163 sacrifices. In relation to the central areas of a quality management system, Quality management system revealed five benefits and 33 sacrifices, Management responsibility revealed 23 benefits and 92 sacrifices, Resource management revealed four benefits and two sacrifices, Product realisation revealed seven benefits and 29 sacrifices, and Measurement, analysis and improvement revealed two benefits and seven sacrifices, see Figure 3.

The analysis identifies that an immense number of value drivers, both creators and destroyers, can be traced to the area 'Management responsibility'. The value creators mentioned by the respondents within this area are e.g. the 'relationship between the PTA and operator', which several perceive as positive. Also, since the two organisations had gotten new CEOs, 'cultural changes' took place. Further, a 'professional attitude' on the part of both the PTA and operator is perceived as a benefit in this business-to-business relationship. As in relation to the business-to-customer perspective, certain prerequisites can be traced to 'Management responsibility' and perceived as value creators. Such prerequisites are the agreement and the perception of the market as well-functioning.

The value destroyers that can be traced to 'Management responsibility' are e.g. 'indistinct responsibility conditions and routines at the PTA and operator', i.e. the two actors do not hold the correct information as whom to address in certain matters. Also, the 'relationship', 'information', 'communication' and the 'agreement' are perceived as deficient. Several of the respondents still perceive the relationship between the PTA and operator as strained after the problems that occurred in 2005, with frequent traffic delays followed by numerous of customer complaints. Further, information and communication between the two business partners can be improved. They rarely meet in person and discuss common business strategies and plans. Instead, the PTA often calls for a meeting to discuss a problem that has already occurred and there is a need to immediately deal with the situation. There is a lack of systematic routines between the PTA and operator in their joint value creation processes for customers. Also, certain prerequisites, such as the agreement deficiencies, e.g. 'breaches of agreement', 'indistinct agreement' and the 'lack of knowledge concerning the agreement', are perceived by several members of this inter-organisational relationship as value destroyers, which can be traced to 'Management responsibility'.

Individually, the most frequently mentioned value creator in the business-to-business domain is 'Relationship', which can be traced to 'Management responsibility', and the most frequently mentioned value destroyer is 'Communication deficiencies between the PTA and operator' in relation to 'Product realisation', see Figure 3.
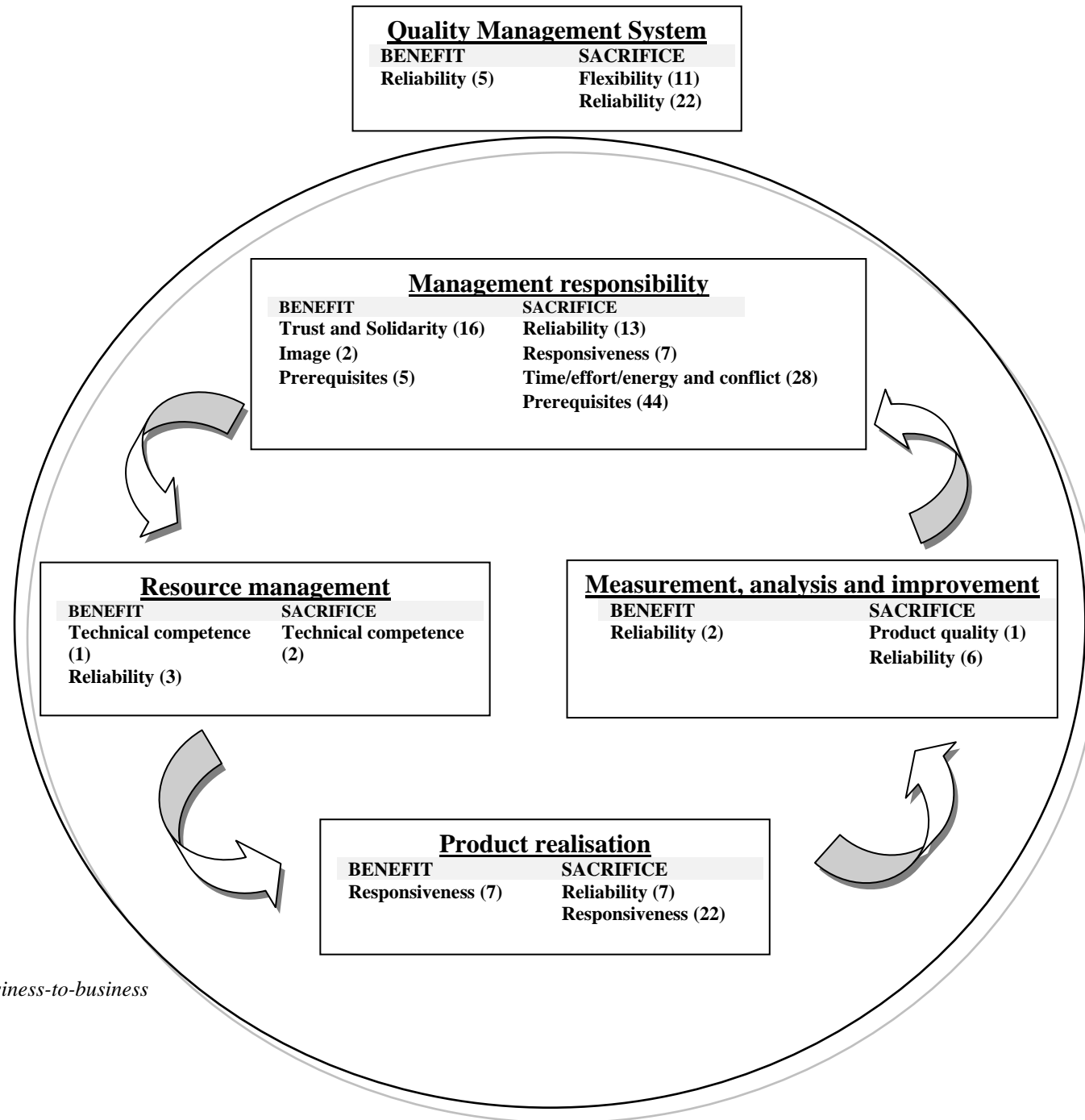
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Figure 3 Domain: business-to-business

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CONCLUSIONS AND DISCUSSION

The aim of this paper was to explore the role of a quality management system for the assurance and improvement of value in an inter-organisational business relationship in the public transportation industry. The study focuses on a business relationship between a PTA and a private operator. The aim was further to illuminate the difficulties in creating value in a context in which the service production has been outsourced.

When comparing the results of the analysis of value drivers with the substance of the ISO 9001:2000 standard and the five areas: Quality Management System, Management responsibility, Resource management, Product realisation, Measurement, analysis and improvement, the greatest number of value creators (benefits) are related to 'Product realisation' and the most value destroyers (sacrifices) are related to 'Management responsibility' and 'Measurement, analysis and improvement' within the business-to-customer domain. Further, the most value creators and also the most value destroyers are related to 'Management responsibility' within the business-to-business domain. These results show how several value destroyers can be traced to internal processes within this business network, which leads to inefficiency. These conditions in turn influence the operative, customer-oriented processes negatively, making this network ineffective as well.

In reference to the PDCA cycle (Deming, 1986) and the results of this study, it becomes apparent that these business actors individually plan for their activities and perform them. However, the joint routines for evaluating how well they are performing in relation to their customers' requirements and for acting upon these data in order to improve the processes, both internally and in particular externally, towards their customers, are appreciably lacking. Consequently, the systematic routines, both within the two organisations separately and also in their joint value-adding activities, need to be overseen and improved. New routines, in particular regarding their performance in relation to customers' requirements, should also be implemented if this network aims to improve the value creation for customers.

The source of this business relationship is the contractual agreement. As the agreement is formulated with a production-oriented approach, lacking the customer-oriented incentives, this causes the business network to be deficient regarding service quality. Also, the requirements in the agreement can be interpreted in an immensely different number of ways, which causes conflicts between the two business actors, as they are driven by different interests, i.e. the operator uses the agreement to its own interests. The two organisations do not view themselves in a value-creating, customer-oriented business network. Instead, they are more like two solitary entities that focus on their own internal activities, i.e. their attention each lies in the management and support processes, giving insignificant consideration to their joint external, operative processes. The information and communication aspects were perceived by both managers and employees at the PTA and operator as deficient. The interviews revealed that the two actors do not meet regularly, they do not share sufficient information and common business strategies and they do not develop value-adding routines for their common customers.

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The development of a quality management system is a strategic decision made by an organisation, and the commitment of management and top management is critical to its success. As many perceived value drivers in this study are perceived as sacrifices, and also can be traced to 'Management responsibility', it should be a priority for the management to understand the stakeholders' requirements, develop processes that add value for them, obtain results of process performance and effectiveness and continually improve the processes based on objective measurements, thus to develop a QMS that decreases the value destroyers, i.e. identifies, measures, analyses and manages them. Further, as the object of study is an inter-organisational relationship, this requires joint routines in a quality management system in the co-creation of value for customers. For this business network to be successful, both internal efficiency and external effectiveness are a necessity. As the contractual agreement serves as the basis for this business relationship, the agreement ought to be reviewed in its forthcoming edition regarding the potential for operators to interpret its contents and, more importantly, to include incentives for service quality with a customer-oriented approach.

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Developing Quality
– Managing Requirements over the Entire Product Life Cycle

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Abstract

Purpose: The consequent alignment of organizations efforts on requirements towards customer satisfaction sets out the fundament for corporate success. To achieve this objective, the entire life cycle of a product (PLC – Product Life Cycle) has to be considered as relevant for product development. Within the PLC, requirements appear in different instances. Looking comprehensively at the product development process, it seems straightforward to document the information collected during the life cycles of different products and to make it accessible for future development projects.
Approach: This paper presents an approach to reasonably consider, document and link requirements with requirement-relevant instances in order to achieve an improvement to product development. This approach ensures the use of an up-to-date requirement set at each stage of the entire PLC by instantaneously taking upcoming information into account.
Originality/Value: Although the consequent structuring of requirement-relevant instances allows the selective allocation by relevance, all information is documented so that this provides advantages to subsequent projects. With the "reuse" of requirements, this information comes into focus again and the consequent and structured documentation offers the possibility to improve the initial requirement set and therefore to start with a better information base.
Findings: Employing a continuous consideration of requirements, today's problems in product development may be resolved and the development process may be adjusted to future needs.

Keywords: Requirements management, Product development process, Product life cycle

THE ROLE OF REQUIREMENTS WITHIN PRODUCT DEVELOPMENT

The consideration of requirements takes a central position within the context of product development. This development comes along with the more rigorous warranty deeds and the increasing customer orientation and – more recently – the spectacular failures and delays of various multi-million-dollar projects like the baggage handling system at Heathrow Airport in London (failure) or the development of the Airbus 380 (delay). Against this background the precise elicitation, structuring and processing of requirements, in short the requirements management, plays a crucial role within an organization and especially within product development. Furthermore, numerous standards and guidelines in the field of quality management build up on the orientation of organizations on requirements. State-of-the-art process models presuppose well-defined requirements as the initial point of the product development (Möhringer, 2005, Ehrlenspiel, 2003, Pahl/Beitz, 2003). This includes external as well as internal requirements.

MISSING CONSIDERATION OF REQUIREMENTS OVER THE ENTIRE PLC

Following the common understanding, successful product development is based on a profound understanding of the "Voice of the Customer" (cf. Katz, 2004). As there are in addition to the customers further involved persons or organizations whose specifications have an effect on the product, the stakeholder concept often is employed (cf. Jockisch et al., 2007, p.34). According to Ulrich and Eppinger the stakeholders "(…) are all important parties who are involved with the effective delivery of the product to the end user and the support of the product throughout its life cycle" (Ulrich/Eppinger, 2004). According to the ISO 9000 as the most relevant standard (DIN, 2006), quality aspects are closely tied to requirements. For instance, the "degree to which a set of inherent characteristics fulfils requirements" is defined as quality (DIN, 2006, p.22). An orientation on their requirements and a systematic management of the requirements is therefore one approach to successful product development. There already exist well-established supports to document requirements such as requirement list, tender specifications or performance specifications (VDI, 2001). As helpful as they are to give an overview of the stated requirements, they tend to be static documents, which do not evolve over time. Furthermore they are largely one-dimensional, meaning that they do not consider interactions between requirements. Bearing in mind further need for methodological support, e.g. for the elicitation and structuring of requirements or the conversion of requirements into product features, tools like the QFD (Akao, 1990) are largely applied. Within its underlying interactions with the products functions and processes (cf. Winzer et al, 2007); requirements tend to behave dynamically over time. Moreover, to work on the basis of an up-to-date requirements set, the classical time frame of requirements management – so far commonly the phase of the product development – has to be extended to the entire PLC. The consideration of quality as the fulfilment of

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requirements as well as the orientation of process models upon requirements justifies an in-depth analysis.

For further processing, it has proven to be essential to characterize the requirements in adequate detail. This concerns an explicit description in terms of formalization (Crostack et al., 2007) as well as an attribution of channel, source and further information (Jung, 2006).

Supplementary to their elicitation, a continuous requirements management has to consider and to support the structuring and processing of requirements. This includes the identification of interrelations, the orientation on decisive criteria and as interface to the design process, the translation of requirements into product features. Well-established methods like QFD only partially consider these aspects. Particularly, the retention of a current requirement set is only partially addressed. In terms of a continuous requirements management over the entire PLC, it becomes evident, that the existing static methods do not cope with the dynamic development of the requirements.
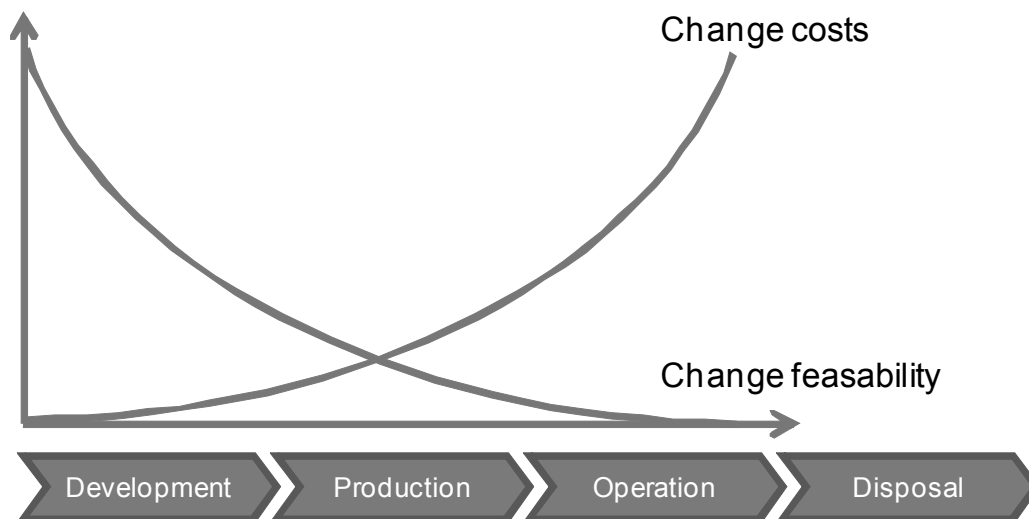
Figure 1: Development of change costs and change feasibility during the PLC

As figure 1 depicts, changes in product features are feasible in the early stages of the product development at a relatively low cost. As product development evolves or the product is already in operation, the change costs increase dramatically as well as the change feasibility decreases.

At the beginning of each product life cycle, the investigation of the stakeholders' needs and expectations results in an initial set of requirements. In the course of the development process:

- new requirements appear,
- existing requirements get modified or replaced,
- requirements turn out to be no longer relevant.

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Supplementary to the dynamic development of requirements, further articulations are made by the systems' stakeholders. As the following detailed explanations show, they are closely tied to the requirements and have to be considered in order to employ a continuous requirements management.

Already in product development, but especially during the validation stages, **change requests**, **failures** and **disturbances** appear. Within the operation of a technical system, **complaints**, **damages** and **warranty claims** may occur.

All the highlighted expressions do have a common basis in the comprehensive consideration of requirements over the product life cycle. However, some of these "requirement-relevant instances" occur in downstream stages of the PLC. That may be a reason for their merely isolated treatment.

This paper presents an approach to reasonably consider, document and link requirements with requirement-relevant instances in order to achieve an improvement to product development. This approach ensures the use of an up-to-date requirement set at each stage of the entire PLC by instantaneously taking upcoming information into account.

Although the consequent structuring allows the selective allocation by relevance, all information is documented so that this provides advantages to subsequent projects. With the "reuse" of requirements, this information comes into focus again and the consequent and structured documentation offers the possibility to improve the initial requirement set and therefore to start with a better information base.

REQUIREMENT-RELEVANT INSTANCES

As well as the consideration of requirements in the beginning of the product development is largely common sense in engineering, it is almost impossible to gather a complete set of requirements to engineer a product upon. This is due to the isolated static recording in the beginning of the product development. Even using sophisticated methods and tools to elicit requirements (Jockisch et al., 2007) it is likely to exclude stakeholders or implicit requirements. Referring to this problem, iterative approaches to a continuous updating of the requirement set during the product development are discussed in literature (Sitte/Winzer, 2007). They basically build up on the idea that the requirements set is improving, if information out of the product development process is used to refine it. But as these approaches lead to more sophisticated requirement sets, tender and performance specifications, they stop with the end of the product development process. As further requirements appear afterwards – during downstream stages of the PLC, we develop the concept of requirement-related instances to overcome the current static documents replacing them by a dynamic requirement set.

The ISO 9000 (DIN, 2006) defines the term requirement as "need or expectation that is stated, generally implied or obligatory."An initial requirement, stated in the beginning of the product development process, could be the following:

> *"The appliance has to convey packaged goods at a minimum speed of 2 meter per second."*

Requirements tend to evolve dynamically over time. Supplementary information about changes and modifications as well as about their non-fulfilment or non-consideration appears. Already in the product development stages, wishes, needs or expectations to

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alter the requirements may be articulated or carried out. To maintain the link to requirements we introduce the term requirement-related instances for the following:

A **change request** can refer to either a requirement or a feature to fulfil a requirement. Whereas in the first case the requirement itself is directly modified, in the second the requirements are modified indirectly by the justification of this modification and its consequences. As often not requirements but characteristics are subject to change requests (as for the following instances as well) the relationship between product characteristics and requirements has to be considered. To achieve this, structured approaches to link product features and requirements like QFD or DeCoDe (cf. Sitte/Winzer, 2004) can be employed.

> *"The appliance has to convey packaged goods at a minimum speed of **3** instead of **2** meter per second."*

Within the entire PLC, requirements that are not fulfilled become visible in the form of **nonconformities**, defects, failures, disturbances, damages or faults. All of these instances (in the following referred to as nonconformities) presuppose an implementation of the requirements in product characteristics. They initially arise in test stages and may occur until the end of the PLC.

> *"The appliance conveys packaged goods at a maximum speed of **1.5** meter per second."*

If nonconformities occur after the delivery of the finished product they are often not recorded or even perceived by the manufacturer, but by the customer. If these nonconformities exceed a tolerated extent, the customer will make a **complaint**.

> *"The goods do not arrive in time."*

In this case either a defined and considered requirement has not been fulfilled or the requirement has not been considered in product development. The former indicate a noncompliance with a (contractually) guaranteed specification and result in **warranty claims**. Complaints which are not based on considered requirements may pinpoint the customers' needs or expectations which have not been fulfilled and thus implicit or new requirements.

Although customer complaints generally occur in the operation stages, even in upstream stages of the PLC complaints may be made – mostly by internal stakeholders. Figure 2 displays the appearance of requirement-related instances during the PLC.

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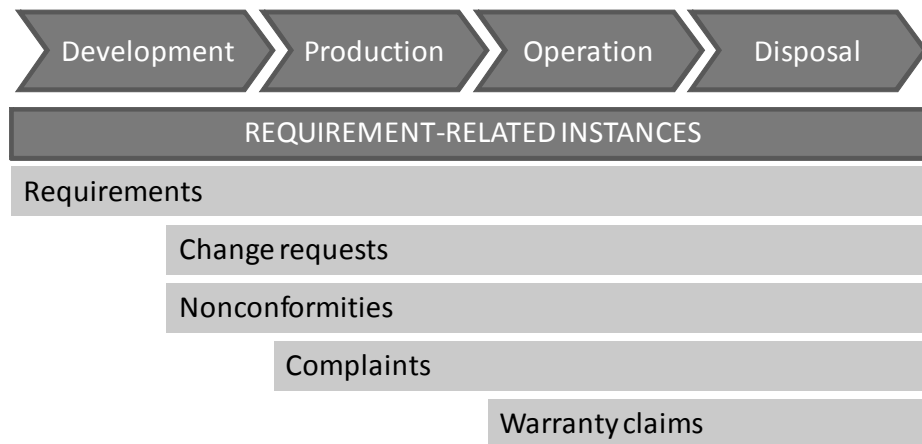Excellence; 20-22 August; 2008 in Helsingborg; Sweden

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Figure 2: Appearance of requirement-related instances during the PLC

Even though these instances refer to requirements and consequently to the fundament upon which product development builds up, there exist only isolated approaches to collect and structure this information.

NEED FOR A CONTINUOUS REQUIREMENTS MANAGEMENT

Because a statement regarding a products' quality is implicitly assuming a profound knowledge about the requirements of the involved stakeholders, it is necessary to observe them over the entire PLC. Within its progress, new requirements appear, existing ones get modified and previously important requirements may turn out to be irrelevant. Because requirements trigger the product development in order to achieve good quality products, a continuous management of requirements allows the transfer of knowledge in terms of requirements patterns to future development processes. In case of a structured documentation of the requirements and their history, patterns of implementation that proved to be successful may be transferred to other development projects and even create new product ideas. Due to a qualitatively as well as quantitatively better data pool, product development can be adjusted to meet the requirements, thus over- and under-engineering may be prevented. Additionally, the continuous alignment on requirements enables a functional dimension. If requirement-relevant instances are explicitly defined, they provide guidelines for an integrated development over various engineering domains, avoiding misinterpretations due to different domain-specific vocabulary, backgrounds or experiences. Based on information flows, an approach to accomplish a continuous requirements management to collect, document and link these requirement-related instances will be presented.

CONCEPT FOR A CONTINUOUS REQUIREMENTS MANAGEMENT

According to (Pfeifer, 1996, Winzer, 1996) information flows provide the background for a dynamic planning, controlling and managing of business processes. They represent the interfaces between the several subtasks (processes) of an organization. The analysis of the information flows aims at a representation of accumulations and deficits of information as well as at the exact description and definition of the information required

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within the respective processes. This analysis provides starting points for an optimized configuration of information flows. Because information flows connect processes and sources of information (imu, 2003) their consideration along the entire process chain allows an optimization and therefore an optimization of the business processes (Braunholz, 2006, Müller, 2006).

Requirements and the considered requirement-relevant instances represent a subset of process information. The application of the information flow analysis could therefore be useful to specify the requirements for the given processes to trace and manage them along the process chain and therefore over the entire PLC.

CREATING A DYNAMIC REQUIREMENT SET

To manage requirements over the entire PLC using the concept of information flows we firstly consider the entirety of requirement-relevant instances as a **requirement set**. This set contains the information about requirements, change requests, nonconformities, complaints and warranty claims coming from inside or outside the organization (internal or external information). To orientate on requirements the interrelations between requirements and the other instances are analyzed (cf. figure 3).

		REQUIREMENT SET							
		R_1	R_2	R_3	R_4	…	R_{32} New	R_{33} New	R_n
REQUIREMENT-RELEVANT INSTANCES (requirements – R, change requests - CR, nonconformities - NC, complaints - C, warranty claims - WC)	R_1						N		
	CR_1	C							
	CR_2			C					
	NC_1			C					
	C_1							N	
	WC_1				D				

Information (internal)

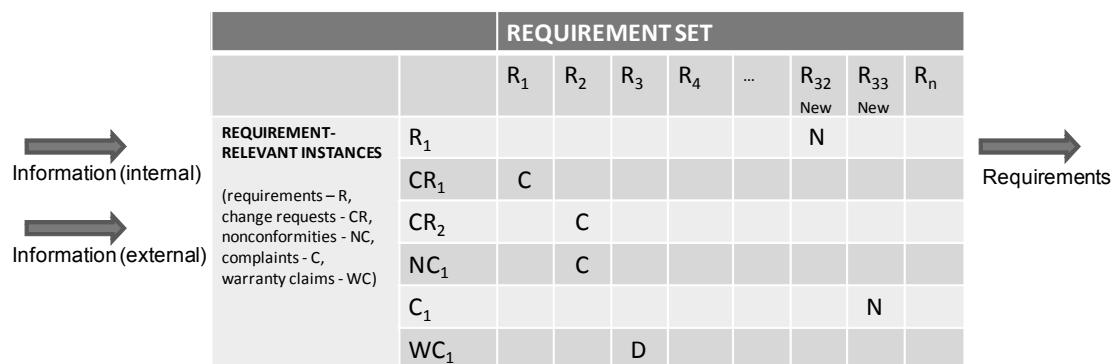Information (external)

Requirements

Figure 3: Information as in- and output of the requirement set

By means of this comparison it becomes possible to analyse and rate the requirement-relevant instances. Based on this comparison, requirements get changed (C), new requirements appear (N) or requirement turn out to be irrelevant and get deleted (D). After the identification of these relations, the requirement set has to be updated in order to be used within the following processes. If a requirement-relevant instance causes an alteration of a requirement, additional information about its fulfilment may be additionally assigned. Using this approach alongside the PLC a dynamic requirement set can be created. The update of the requirement set should be carried out directly following a process step to display the contribution of the respective activities regarding the fulfilment of the requirements.

STRUCTURE OF THE REQUIREMENT SET

Dealing with the elicitation and the collection of requirements inevitable problems of imprecise, diffuse or mistakable formulation occur. These problems are closely tied to

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(partially) incomplete requirements. Therefore research (Gebauer, 2001, Heimannsfeld, 2001, Jung, 2006) has been done to establish (semi-)formal descriptions of requirements to start the process of requirements management on a common understanding of the requirements. Although the specification of the elements of a requirement does not solve all problems in the field of requirement elicitation – as recurrent difficulties to establish classifications or concepts of formal ontology show – but offers the opportunities of a structured data filing. Crostack (Crostack et al., 2007) defines source, priority, reference, surrounding conditions, and status as key elements of requirements. Upon this base a template to document requirements in the field of intralogistics has been created. The structure data filing by the help of this or a similar template supports a distinct definition of requirements. This has to be considered at the latest during the connection with the further requirement-relevant instances and – considering interdependencies – in the course of developing product and process attributes.

In addition to the requirements the further instances have to be filed in a structured way. Because the continuous consideration links them closely to requirements, their structure has to build up on the requirements' structure as well. In particular for the rating of the importance and the appropriate measures, the structure has to be amended by attributes about the relevance of the information. The scope of the requirement-relevant instances may be diverse, depending on the reference as a change request, nonconformity, complaint or warranty claim. E.g. the appropriate initiation of recall actions regarding urgency issues may be an outcome of the dynamic matching with the requirement set.

USING THE REQUIREMENT SET

The updated requirements originating from the requirement set constitute the input information for the operation of the respective downstream processes. However, caused by the operation of process steps requirements-relevant information may be altered, deleted or result in new requirements. This implies that requirements have to be verified with respect to their up-to-dateness (figure 4).
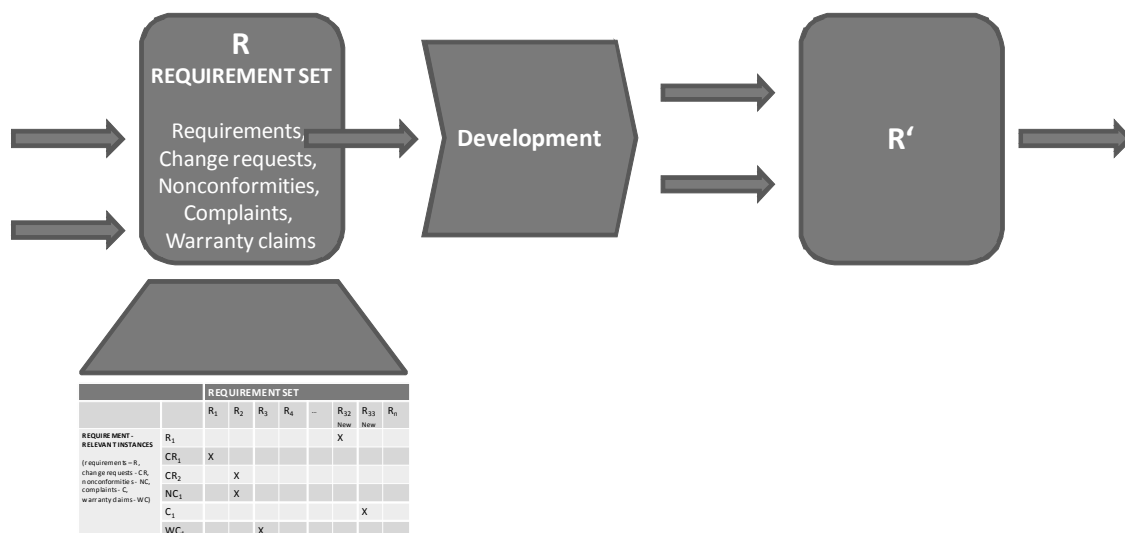

		REQUIREMENT SET							
		R_1	R_2	R_3	R_4	--	R_{32} New	R_{33} New	R_n
REQUIREMENT-RELEVANT INSTANCES	R_1						X		
	CR_1	X							
(requirements – R,	CR_2		X						
change requests – CR, nonconformities – NC, complaints – C,	NC_1		X						
warranty claims – WC)	C_1							X	
	WC_1			X					

Figure 4: Operation of the requirement set

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SYNCHRONIZATION GATES

The division of labour and thus the parallelization of processes within a production system frequently lead to problems regarding the definition of the interfaces. Therefore it may be possible to simultaneously carry out the updating of a requirement set in distinct processes. This may implicitly cause different views and ratings. Knowing the information flows, synchronization gates as displayed in figure 5 can be defined at positions within the process chain to level the fuzziness of the requirement set due to its parallel treatment. They allow a comparison of different requirement sets, resulting e.g. from parallel processes. Therefore the requirement-relevant instances can be consolidated and passed on to the following processes. A tracing of the requirements and its relevant instances thus becomes possible. By the means of these synchronization gates it can be guaranteed, that the relevant processes including their information are considered in order to maintain a current, valid and adjusted requirement set.
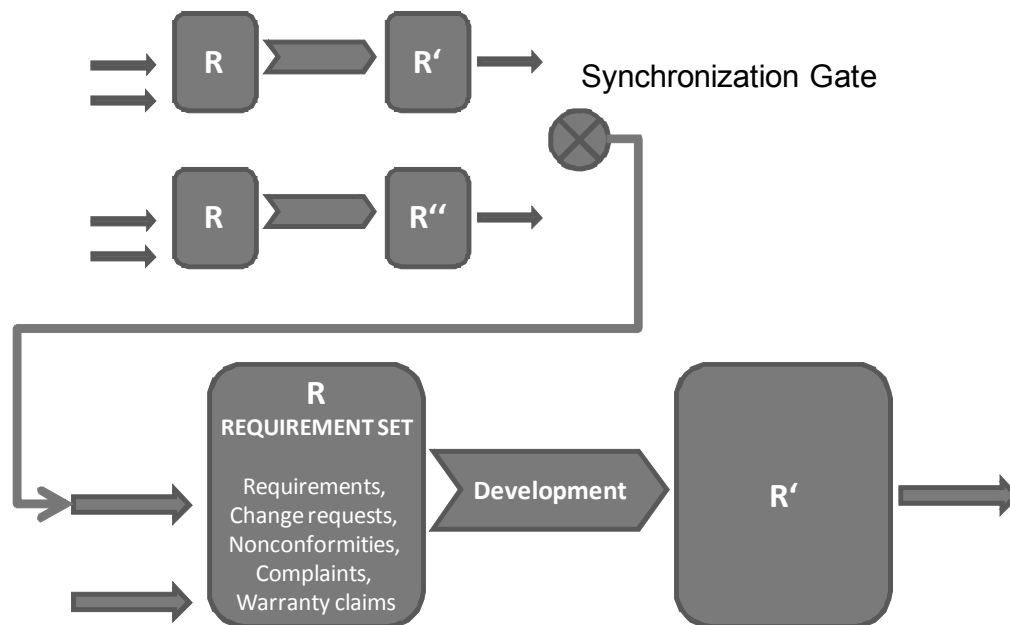
Figure 5: Positioning of synchronization gates

FINDINGS

The concept of employing requirements as a pre-requisite of product development is already widespread. Quality as well as customer orientation and strategy concepts build up on this idea. Though, running business processes, ruptures of a comprehensive requirements management often occur. This paper pinpoints the different instances of requirements and potential interfaces following the objective to achieve a requirements management over the entire PLC.

We developed an approach for a continuous requirements management based on systematic connection of requirements with downstream so-called requirement-relevant instances. To analyze their development over the entire PLC, a concept based on the consideration of information flows was presented.

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Employing a continuous consideration of requirements, today's problems in product development may be resolved and the development process may be adjusted to future needs.

1. Products may better fit the actual requirements and thus an over- or under-engineering may be prevented.
2. Expensive product recalls can be avoided.
3. Based on a common understanding of requirements different involved parties, languages and organizations may be coordinated more easily.
4. By a comprehensive orientation on requirements, the development of follow-up products can be started earlier.
5. The development stages of follow-up products shorten because of already documented interrelations between requirements and design parameters.
6. A more structured filing of the collected knowledge becomes possible.

The research approach does not focus organisational or computing aspects of requirements management but is limited on a comprehensive structured consideration of requirements over the PLC and the integration of existing methods.

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Impact of Culture Based on Human and
Soft Issues on Software Quality in Pakistan

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Abstract

Pakistan's IT industry has been rising steadily since the last three years [1]. Being a relative new industry, it is struggling for maturity and better quality (140 out of 1161 companies achieved international process or product quality certifications like CMMI or ISO certifications). Most of the struggles for software quality focus on the technical aspects of development process with little or no regard to Human and soft issues [2]. These issues can be an important factor to achieve high productivity and quality. Unfortunately it is generally believed in most software companies in Pakistan that soft issues like *Motivation, Job Security, Salaries and Incentives, Employee's Sense of Ownership, Team Building, values, Individual Self Respect and Dignity, Open Communication, Skills Enhancements and Leadership Style* are not important by respective managers. The paper analyzes the software industry of Pakistan with respect to human and soft issues. It explores whether these soft issues have considerable impact to achieve, enhance and sustain productivity and quality. If yes, then how these issues relate to quality, and if not then how its influence could be highlighted to the policy makers.

Value of Research

This study will help the software development companies, especially in Pakistan to identify the key cultural human issues and will help them to transform the organization's culture toward better environment that would be the indicator of better quality.

Purpose

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The aim of this paper is to analyze the role of human and soft issues for achieving better quality. This study will explore how software companies can consider these issues that could help them to strive for inexpensive, yet least known ways to achieve *product quality*. Findings of this study will also assist Pakistani software houses in increasing the productivity of their employees. It will also enable organizations to realize the importance of *Cultural* and *Human* issues in their working environment.

Research Methodology

Commonly practiced research method was used for analyses. A comprehensive survey was conducted in selective software houses operating in Islamabad and Rawalpindi. This survey focused on identifying the soft factors satisfaction level in the software industry of Pakistan.

This research will compare the cultural and soft issues in different categories (organizations with quality certification, organization without quality certification and such companies which are reputed well in the IT industry) of the software industry and then shows the impact of these factors on the productivity and quality of the work of the employees.

To generalize the results the culture, values and trends at these companies could also be catered. Moreover, the labor laws regarding these soft issues should also be considered while generalizing and implementing these results. The study will also define all soft and human issues.

Research Findings

On the basis of survey instrument, available literature regarding subject and discussion we have so for, we found the followings results.

- ➢ Along with the process improvement work environment conditions can effectively be used for performance and quality improvement.
- ➢ Emerging IT industries can rapidly get maturity in quality by addressing human related problems
- ➢ Organizations in our software industry which are considered better places to work, are giving more attention to human related issues
- ➢ Salaries and benefits that do not satisfy employee basic needs, cause dissatisfaction to employee which leads to major human resource issues that at crucial project time may result in low productivity and low quality
- ➢ Training and skill enhancements are not practiced satisfactorily in our industry which is also causing poor performance
- ➢ Leadership's role practiced here is still supervisory instead of facilitator which is also a major obstacle in low productivity and hence quality.

Keywords: Software quality, Soft issues, Human issues.

Paper Type: Research Paper

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Introduction

Much of the studies involving software quality has focused mainly technical aspects of the process improvements and ignored human and soft issues which are inevitable to achieve a high quality product / project. Studies have shown that process improvement ensures limited increase in productivity. The maximum influence of process maturity on the project's productivity is 1.43 times. Moreover this effect varies as the project size changes [2]. The study does not deny the role of process maturity instead it emphasis that along with technical improvements human and environment related problems should be considered to gain full benefit and to maximize productivity and quality. Following is the brief description of soft factors which should be considered to enhance productivity and quality on the basis of available literature on the subject.

Motivation

Although a lot of studies have been conducted that deal purely with employee motivation (that influence productivity and quality) but it is such a vast subject that can't be quantified exactly. Studies have proved that motivation is the most important factor for productivity and quality [4].

A lot many factors involve in determining the motivation level of a particular person and these factors vary person to person. Besides this reality we can't deny its role as a best tool to achieve high productivity and quality in any situation.

Many of the soft factors under study are directly or indirectly involved with the motivation or to each other. Like Sense of belonging /ownership, Job Security, Rewards and Incentives, management Style and good work life balance are considered as extrinsic motivators for productivity and quality while Team Building, Trust and Respect, Employee participation and Appreciation are categorized as Intrinsic motivators for productivity [5].

Job Security

With the advancement of new and emerging communication means especially internet, the world has become a global village. These new technologies played a very important role in the development of other industries as well as it enhanced itself. Many foreign organizations are now out sourcing their projects to developing countries like Pakistan. In addition to the benefits it has encouraged people to establish their own small companies and many of them are forced to close if they don't find enough projects to sustain their expensive and hence the life of the company. This has created a type of job insecurity in the IT work force that is also affecting the productivity and quality of the software.

Salary and Incentives

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Hertberg's motivation theory addresses two factors *Motivation* and *Hygiene*. Hygiene factors like salary, working conditions etc are needed to ensure that employees are not dissatisfied [8]. Salary if not comparable with the employee duties and responsibilities will lead to job dissatisfaction. Moreover employees need to be cared about and praised and recognized for quality work [6].

A survey conducted by PSEB (Pakistan Software export Board) has shown that average salary of the employee working in the organization that is involved in domestic development is less than that of the employee working in the organization involved in the export of the software. This factor has created an environment of job switching on the basis of the more material benefits which is producing an environment of very unstable resource level. Frequent jobs switching are not only creating human resource problem but also badly affecting the quality and productivity of the organization.

Employee Sense of Ownership

All companies have to deal with issues regarding their employees. It is no secret that employees who feel a part of their organization and feel as though they are making contributions to the growth and success of the company will give the extra effort.

Large organizations like Microsoft win the trust of their employee and make them feel a very important part of the organization. This motivates the employee to the extent that they become willing to go beyond the limits to help make their organization succeed. The key factor in motivating employees is creating a sense of affiliation within the organization. Higher level of belonging sense not only increases productivity but also increases retention rate.

Employee Self Respect and Dignity

Quality culture emphasize that all the co workers should be treated and behaved well irrespective of their designation and role. The beliefs, values and rules (regarding ethics if defined in the company) lay the ethical culture and environment of the organization in which people would behave and treat each.

Open Communication

Communication is another very important factor which plays central role in success of the software. Effective send efficient communication is inevitable to achieve the desire output. Informal and out of the routine communications are very helpful for workforce to solve their small problems and thus save them a lot of time and rework. Moreover, these informal discussions give the opportunity to the employees to learn more and develop very friendly relations with each other that positively add toward a better working place.

Skill Enhancements

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Information technology perhaps is the only industry which is changing so rapidly. Everyday new tools, techniques and methodologies are emerging. This ghastly changing technologies demands high and frequent training and skill enhancement needs. These training and education activities can motivate employees and enable them to be more creative and innovative.

Leadership Style

The role of the leader or manager for achieving goals is very pivotal. The purpose of leadership should be to produce pride in people by empowering them and to create loyalty and sense of belonging by making them responsible. Studies have proved that personal appreciation or acknowledgement of the worker's success plays a very important role to increase his/her interest in achieving goals that ultimately will have positive effect on the productivity and quality.

A manager that prioritize the tasks or job of his/her employee will be able to manage his/her schedules timely and efficiently than who does not care for it. Moreover regular feedback on the worker's performance is more effective than annual or six month appraisal. To enhance quality and productivity managers' role must be as a facilitator rather than as an executive.

Team Building

In Software development Team Building plays a very basic role. Although team building is a Hygiene factor but its absence de-motivates people [3]. If employee is considered as an important member in the team and his/her contribution is valued then undoubtedly he/she will go beyond the limits to maintain hi/her image.

Analyses of Data

A comprehensive survey is used to collect the data about the above mentioned factors. We have gathered 51 responses from 17 different organizations in which professionals of both genders (male and female) having experience ranging from junior developer to senior level manager participated. In the figures (1-3) soft factors are mapped in short name which are given in the table below.

Soft Factors	Short Name
Motivation	Mot
Job Security	Sec
Salaries and Incentives	Sal
Ownership	Own
Values, Self Respect and dignity	Val
Open Communication	Com
Skill Enhancement	Skill
Leadership Style	Lead
Team Building	Team

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Table I

Pakistan IT Industry and Soft factors

The figure 1 shows the extent to which these soft factors are being practiced and considered in the organizational culture of IT industry in Pakistan. Values, Self Respect and Dignity and Team building are better than rest of all. Salary and skill development are the factors which scored less and need to be given a serious attention. Motivation, Job Security, Sense of belonging and Leadership style has scored a bit better but they should be improved to enhance productivity and quality.
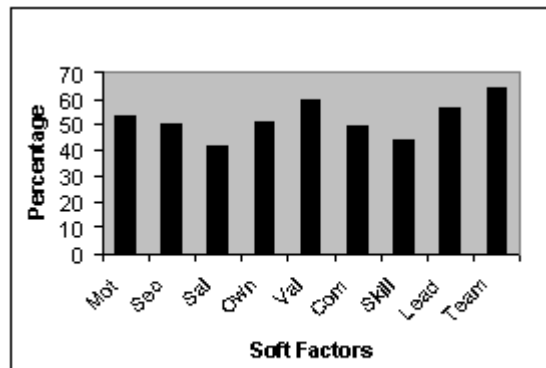
Figure 1: Condition of Sof Factors in IT Industry of Pakistan

According to the PSEB statistics about 13% of the IT organizations in Pakistan have achieved CMMI or ISO software quality certification. Figure 2 shows the comparison of the soft factors being practiced in companies having some quality certification and having no quality certification. The analyses show that with exception of *Skill Development* there is very minor difference of these soft factors condition in both of the categories.
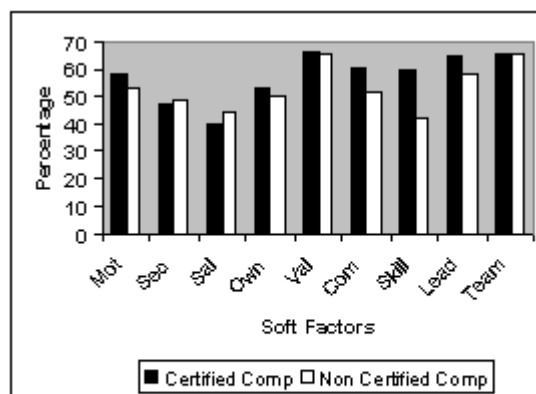
Figure 2: Condition of Soft Factors in Certified and Non Certified Companies

Some of the software organizations in Pakistan are well reputed and are considered a worth place to work at. Figure 3 depicts the consideration of the soft factors in these

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organizations in comparison with over all condition of these factors in the IT industry. Again the results are not different from the one we have in figure 2 i.e. some soft factors like *Values*, *Self Respect* and *Dignity* and *Communications* are relatively scored good in generally better perceived software organizations.
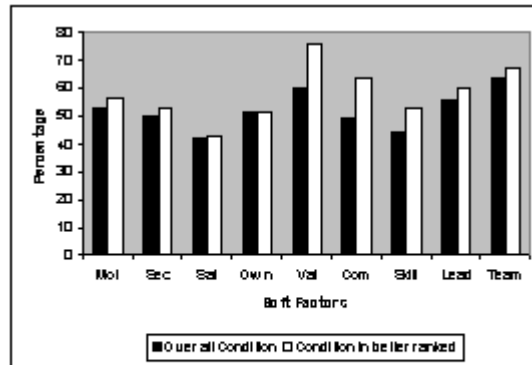
Figure 3: Soft Factors in good reputed Organizations vs
Overall Soft Factors Condition in IT Industry

Discussion

Organization culture and Quality of Work environment is the most important factor that affects the employees the most. People are satisfied and motivated in the environment where they enjoy their work and are appreciated for the work they do. It is environment and values of the Microsoft that they have motivated their employees to an extra ordinary degree that people normally work 12-18 hours days [2]. People are more comfortable and productive where their respect and dignity is maintained both by the manager of their team / project and team members.

Pakistan IT industry is newly emerging where organizations are striving for process maturity. Along with the process maturity it is equally important to consider the culture, environment and employee related issues to maximize the productivity and quality of the IT industry. Human factor is often given the less attention than it deserves, in fact this is the element that can be used to gain full benefit of quality management [10]. A lot many studies in software and other industries have been made to signify the importance of the human and culture effects on the productivity and quality of the employee. One of the study reported by the FORTUNE magazine, it presented a model of the relationship of employee and employer based on trust [11].

The result shown in the figure 1 are not satisfactory because about 50% people are not motivated, similarly people are not satisfied with salaries and skill enhancement opportunities. If work force is de-motivated and dissatisfied either due to salaries or lack of learning then it will have sever effect on the productivity and ultimately to the quality of the work. It is the company environment and leadership not process that produce employee's interest and joy in the assigned tasks and jobs by acknowledging work and

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prove their fairness by providing expected material benefits. Studies proved that soft factors enhance productivity to an astonishing level [4].

Human and Soft Issues vs. Quality and Productivity

The low motivation of the employees can be due to the environment that hinders them to utilize their best talent to achieve their goals. The data collected from the survey instrument depicted that it is the one of the problems that is present in IT industry which is resulting in low productivity. Moreover employee opinion and suggestions are not considered while making decision and setting goals for the teams and even for the whole organization. They do not feel valued and become dissatisfied which in return affects productivity and of course lack of interest which results low quality of work done. Another major human issue that causes low motivation in our software industry is the long working hour. According a survey about 73% of all the projects in the software industry are required late sitting due to unrealistic deadlines. In addition to this developers are not compensated for over timing. This is also affecting the productivity and quality of the software projects. Moreover it is also creating a problem of employee retention and human resource problem.

According to a survey report presented by PSEB (August 2005) the entry level developers working for the companies that are focusing on domestic projects are compensated on the average 11500 RS (Rupees) monthly. Moreover most of the small and newly established IT organization in Pakistan either does not provide benefits and allowances like health insurance, over timings, pick and drop etc. or provide to higher level officials(Project managers, Operation Managers, Directors, CEOs) [12]. The same effect can be seen in figure 1 which graphically showed that about 40% of the people in the sample study are satisfied with their salaries and benefits. Moslow's hierarchy of human need specify that higher level needs like recognition and appreciation become motivators only when lower level needs like salary and appropriate facilities etc. are satisfied [3]. Promotion of salaries and benefits to an appropriate level that can enable IT professionals to satisfy their lower level needs will of course enhance their productivity and quality of work to achieve higher level needs like appreciation and recognition.

Team Building, *Dignity* and *Self Respect* and *Communication* are very important and inter linked components in the culture of software industry. Software development requires people to be very creative, innovative and most importantly mentally alert. This heavy mental involvement demands that people working in groups, should be more cooperative and friendly having strong working relationship. Studies have proved that effective teamwork has strong relationship to motivation [3]. Furthermore team members want that they should be treated well and their respect and dignity should be maintained. Ensuring the involvement of all employees increase satisfaction level and feel themselves valued which motivate them to achieve even difficult goals. In the software development cycle software engineers especially programmers have to discuss their problems with collogues and other team members to gain help or guidance. Research has established that software engineers spend most of the office time by informal communication like helping each other or discussing new tool etc. The environment of software industry should allow them

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to have effective open communication that would have positive effect on the productivity by reducing wasted time. Figure1 shows that these above mentioned three soft factors are relatively more better and about 60 -70% people are satisfied with the Team Building, Self respect and Dignity and Open Communication culture in our IT industry.

Conclusion

This study has shown that productivity and quality of work are directly influenced by the environment and culture where people work. To gain full benefit of the workforce skills and talent we should provide them working environment where they feel valued, respected and affiliated. As we can not ignore the importance of the process improvement and maturity like wise we should address the human and culture related issues to increase the satisfaction and motivation of the people who execute that process.

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Table of Abbreviations

ISO	International Standard Orgnization
CMMI	Capability Maturity Model Integeration
PSEB	Pakistan Software Export Borad
IT	Information Technology

Table II

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Exploring 'Employee Satisfaction' as a Quality and Productivity Enhancement Tool for IT Sector of Pakistan

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Preface:

This research paper is written during the study of course; 'Software Quality Management', offered at CASE, Islamabad, taught by: Mr. Ali Ahsan in Fall 2007. The motivation of this research paper comes from one of the research question that is part of Mr. Ali Ahsan's PhD Thesis.

Abstract:

Purpose - This research addresses the factors concerning 'Employee Satisfaction' that impact quality of work done and productivity in software organization in Pakistan. The research reveals employee satisfaction as an integral factor for organizations in Pakistan for obtaining competitive advantages in terms of both quality and productivity. Employee satisfaction is an attribute pertinent to the workforce, which proves to be a valuable asset for the development of any sector. It is intended that findings of this research can be used to bring improvements in the work being done in the IT industry. This may serve as a valuable contribution in uplifting the IT economy of Pakistan.

Methodology - This research focuses on the factors that cause employee satisfaction or dissatisfaction. Initially factors affecting employee satisfaction were identified from the literature review. After this the relationship of employee satisfaction with quality and productivity was analyzed for organizations in Pakistan. A questionnaire was used in order to collect necessary data. This questionnaire highlighted the factors that are source of satisfaction or dissatisfaction. The questions used in the surveying tool, concerned general level of satisfaction of employees and the belief of top level managers and policy makers about the role of employee satisfaction on quality and productivity. It was ensured that questions were easy to understand, short and less time taking. The survey presented a range of options from 1 to 10 to employees for collecting their feedback. Lowest range depicted strong dissatisfaction and was given a '1' weight age. Whereas highest range depicted strong satisfaction corresponding and was given a '10' weight age. In addition to these questions having a range of options; general questions were also asked from employees in order to obtain understanding for their views. In order to carry out a meaningful, understandable and in-depth statistical analysis, questions were designed in a format that the response could then be easily translated into statistical figures for subsequent analysis.

Findings - *Ahsan, Sajid and Wasim (2008) quote:"Pakistan's IT industry is currently one of the top performers as compared to other industrial sectors within Pakistan [10]. As per the findings of Ahsan (2008), despite the fact that Pakistan's IT industry is competitive, its true potential is yet to be unfolded. Ahsan (2008); states that Pakistan's so called competitive IT industry has to be in lined with the international performers (Particularly South Asian economies). A simple proof of this statement can be obtained from the fact that Pakistan's general economy is $1/5^{th}$ of Indian economy. This must be true for IT sector of both the economies as well, which, unfortunately is not the case as because Pakistan's IT sector is currently $1/27^{th}$ of the Indian IT Sector[10]. Ahsan (2008) believes that partial reason of this unwanted difference may be revenue models, business practices and political situations of the two countries. Other than these Ahsan (2008) believes that several soft issues[11] are also responsible for this industrial difference. Out of the soft issues*

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'motivation' is one such important factor."[12](Note: When Ahsan (2008) says 'Competitive', it is with respect to other industries within Pakistan)

Argument given by Ahsan, Sajid and Wasim (2008) related to the role of motivation as an imperative soft issue for revitalizing workforce can also be reproduced for the discussion concerning the role of 'Basic Employee Satisfaction' as an organization productivity and quality enhancement tool. Employees, being an integral asset of the organizations, impact organizations in accomplishment of their objectives. The impact of employee satisfaction in software industry of Pakistan is relatively less known but plays significant role. This paper analyzes the major causes of employee satisfaction and the impact of employee satisfaction on quality and productivity dimensions in the software organizations in Pakistan. Much of the literature reveals that factors like for instance pay[1], career growth, encouragement, feedback, job interest and work environment influence employee satisfaction directly[2] and therefore affect quality and productivity in one way or another. This paper argues that management in Pakistan's IT organizations should focus on factors affecting the employee satisfaction and manage workforce accordingly.

Limitations - Most of the discussion has been restricted to the factors, already identified in previous research [1], [3], [4], [5], [7], [8], [9] and literature. Survey is conducted only for the IT organizations in Islamabad.

Originality / Value - As said earlier, findings of this research can be used to bring improvements in the work being done in the IT industry. This may serve as a valuable contribution in uplifting the IT economy of Pakistan.

Keywords - Employee Satisfaction, Quality, Productivity.

Paper Type - Research Paper

Abbreviations and Acronyms – IT ~ Information Technology, Organizations ~ IT Organizations within Pakistan, Sector ~ Industry, Industry ~ IT Industry

Introduction:

With the changing IT consumer behavior towards quality and speedy solution, IT organizations now focus a lot on quality and productivity as key surviving tools. This paper argues that the quality and productivity in IT organizations of Pakistan relate directly to 'Employee Satisfaction'. Employee satisfaction has been a major concern for many researchers. Several research studies illustrate the relationship between employee satisfaction and productivity but findings are contradictory. Some prove the positive relationship (Dunnette, Campbell, & Jaastad (1967), Locke, (1969, 1976), King (1970)) while others find no relationship (Bray field & Corckett (1955), Vroom (1964))[1]. According to Richmond, Mccroskey and Davis (1982), "moderately satisfied employees may be more productive than dissatisfied employee; extremely satisfied employees may form the type of work group known as the "happiness for lunch bunch" (Mc Croskey, Larson & Knapp, 1971) and be more of a social group than a work group, hence lowering productivity".[1] Despite the growing focus of international organizations on quality and productivity enhancement, we rarely find any necessary information; analyzing the impact of employee satisfaction on quality and productivity (Information concerning software industry is nearly does not exist. Also, the situation is even worse for Pakistan's IT industry).

Research Scope:

This research examines and presents views of various employees in IT industry of Pakistan concerning their satisfaction level. The impact and correlation of employee satisfaction on quality and productivity of organizations is also studied in this research. Findings and conclusions are drawn after statistical analysis. Recommendations are provided to manage employee satisfaction in organizations in order to be more productive.

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Research Questions:

Research questions of this paper are a small subset of questions identified by Ahsan (2008) in his PhD research report[10]. The questions which are addressed in this paper are as follows (but not limited to); a) What is the general level of satisfaction of employees in Pakistan's IT Industry? b) Is there any affect of satisfaction on quality and productivity within IT organizations of Pakistan? c) What are causes / factors of employee satisfaction?

Data Collection Method:

Data was obtained from research papers, internet, dissertations, journal articles and books. Further, the relevant information was obtained from a survey conducted in 13 IT organizations in Islamabad having more than 40 employees. 33 questionnaires were obtained from employee in these organizations. Interviews were conducted from the high officials. Before distributing the questionnaires, each individual was given understanding of the research.

Data Analysis Method:

In order to analyze data, both qualitative and quantitative methods were used. Moreover, statistical tools were applied on the data for concluding results. These tools include the following:

For Qualitative Analysis:

'Brainstorming' and 'Cause and effect Diagram' were used.

For Quantitative Analysis:

Histogram, 'Bar Graphs', Correlations and Scatter Plots were used.

Analysis of data helped segregation of the factors that lead to employee satisfaction and dissatisfaction, along with the effect of employee satisfaction on quality and productivity. Following factors (independent variables) were analyzed in relation to satisfaction of employees (dependent variable): individual quality of work, commitment level[6], pay[1],[2], career growth[9],[6], work environment[3], supervisor's attitude[3],[5], empowerment[3], feedback[3], performance evaluation[6], well defined job responsibility[3], interest level with the job[3], process quality, organizational quality[7], employee moral and work ethics[4], availability of resources, communication level[3], trainings[6], absenteeism[3],[4], turnover[3],[2], organization standard, quality of work output by the organization[7],[8], customer satisfaction[8], relation with co-workers[3] and productivity of the organization[1].

Factors, showing no impact were discarded from the study after analysis and only those factors were further scrutinized that depicted either positive or negative impact. The data was also compared to previous research and studies so that considerable results could be concluded.

General Analysis:

The statistical analysis leads to the following observations:

Employee's experience is hardly related to employee satisfaction level (correlation: 0.248).

Individual employee satisfaction has significant direct relationship with broad (collective) satisfaction level found within organizations (correlation=0.85). This depicts that the overall satisfaction level of employees in organization increase with the increase in the satisfaction level of individual employees and vice versa.

Evidence has indicated, that dissatisfaction from pay is reduce level of performance (Bretz & Thomas (1992))[3]. The survey analysis depicts that employees having higher pays are more satisfied (correlation=0.79) and their satisfaction level grows if they are given competitive salary packages (correlation=0.56).

A positive relationship exists between employee's interest in job and his / her satisfaction (correlation: 0.49). Although, this relationship is positive, but as compared to other factors, it doesn't show a high impact contributing towards the satisfaction of the employees.

Moving on with our discussion employees taking leaves, due to lack of interest in their work has weak correlation to their satisfaction level (correlation= -0.124) and similar is the relationship of unsatisfactory job

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environment with individual satisfaction (correlation=-0.243). This depicts that employees in Islamabad IT organizations are satisfied with the work they do and the environment provided to them. The reasons for their leave are negligibly either sickness (correlation=0.18) or personal problems (correlation=0.08).

Research reveals that manager's use of leadership behavior influence employee satisfaction and output given by employee and productivity of the organization. The survey conducted, covered few attributes of leadership involving empowerment, encouragement of innovative ideas, ease level of communication irrespective of the designation, fairness in performance evaluation process and feedback given in response to job performance. Results depict positive influence of all these attributes on employee satisfaction. Amongst all these leadership factors provided to the employees from management, encouragement (correlation=0.6), feedback (correlation= 0.69) and performance evaluation (correlation=0.73) show significant and direct impact on satisfaction of employees.

Elaboration of job responsibility influences the satisfaction of employees (correlation=0.56) directly. Similarly organization's objectives definition affect satisfaction (correlation=0.5).

The graph in Figure 1 represents the opinion given by employees that 'Professional Development'[6] influences their satisfaction level. This graph is left skewed depicting the fact that employees do consider career growth as their satisfaction need in an organization. This research reveals that professional development is one of the factors leading to the better productivity of the organization.
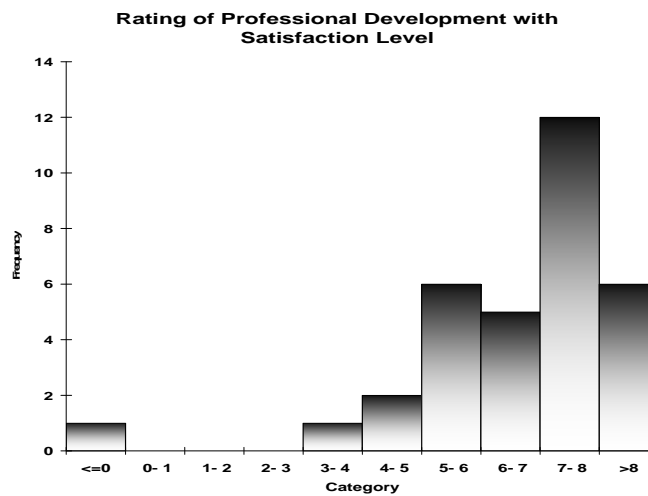
Figure (1): Histogram Depicting Rating of Professional Development with Satisfaction Level

The graph in Figure 2 shows the effects of work environment on employee satisfaction is left skewed depicting employee belief that work environment has strong influence on employee satisfaction.

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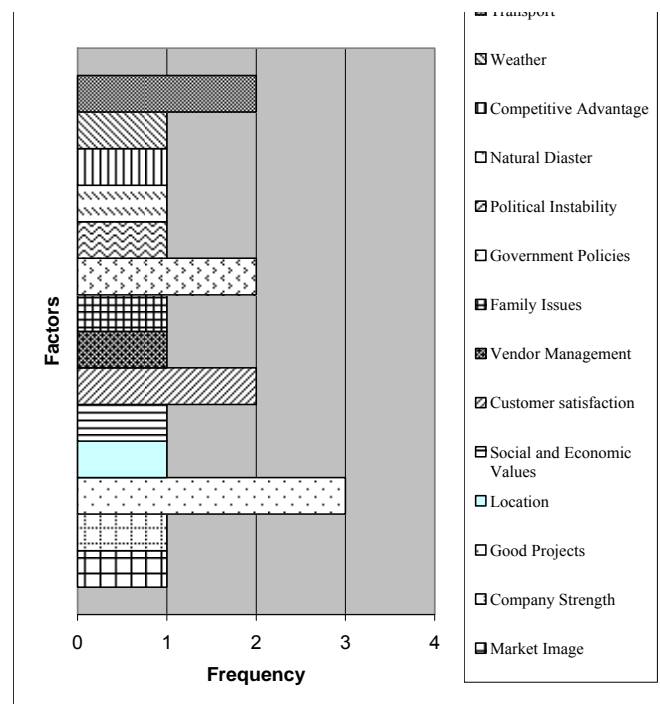*Figure (2): Histogram Depicting Rating of Work Environment with Employee Satisfaction*

Continuing further, employee satisfaction directly impacts the quality of work produced by the organization, (correlation=0.8) thereby, depicting that if employees are satisfied, quality work will be produced. Consequently, employee will be more satisfied by the organization, but if they are not satisfied, quality will be affected negatively. Moreover the analysis also shows, that too much process quality negatively affects the employee satisfaction (correlation=-0.083).

Employee satisfaction directly impacts the productivity of the organization (correlation=0.71) thereby depicting that the organizations that have more satisfied employees are highly productive and organization with dissatisfied employees as less productive.

Literature review depicts that training is one of the four factors leading towards productivity of the organization. About 81% of the sample gives a strong view of the positive impact of training on the output of work they perform, while the rest gave the view that it does affect work output in a normal way. Further, the survey covered three attributes of training; involving current training status of the organization, effective training helping the employees in performing their job well and awareness of technology. The results of the survey show weak relationship with employee satisfaction which means, that proper and effective training is hardly given in the organizations within Islamabad, whereby people are made aware of the new technologies.

Here, it is also important to mention that analysis in this research shows that 94% employees from sample think that satisfaction level directly affects employee ethics and dissatisfied employees are more likely to show unethical behavior in organizations. Only 6% employee thinks that satisfaction has no effect on employee morale and ethics.

The external factors which we have not considered in this research but employee thinks that can effect employee satisfaction, are government policies, transport, good projects, company strength, social and economic values, political instability, natural disaster, location, vendor management, weather, and family issues (Figure 3).

Figure (3): Simple Bar Graph for External Factor that Affect Satisfaction

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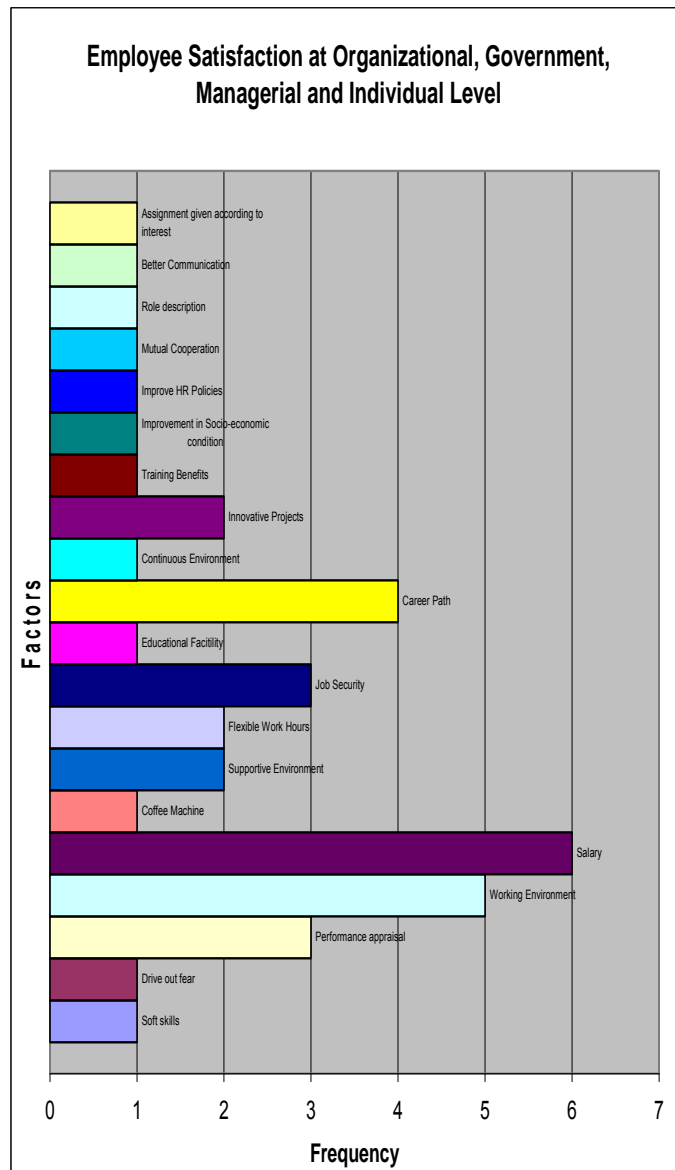
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The research survey for this paper focused on two major areas i.e., Quality and productivity being influenced by employee satisfaction. Whereby some novel areas are also put forward by the employees during the survey including teamwork, motivation, policies, innovation, family and social life and employee loyalty (Figure 4 clarifies).

With the discussion above, research reveals that generally employees also think that if the employer at organizational level provides factors like job assignment according to employee's interest, effective communication, succession planning, beneficent HR policies, better compensation packages, job security, working environment and timely feedback, then they can increase employee satisfaction.
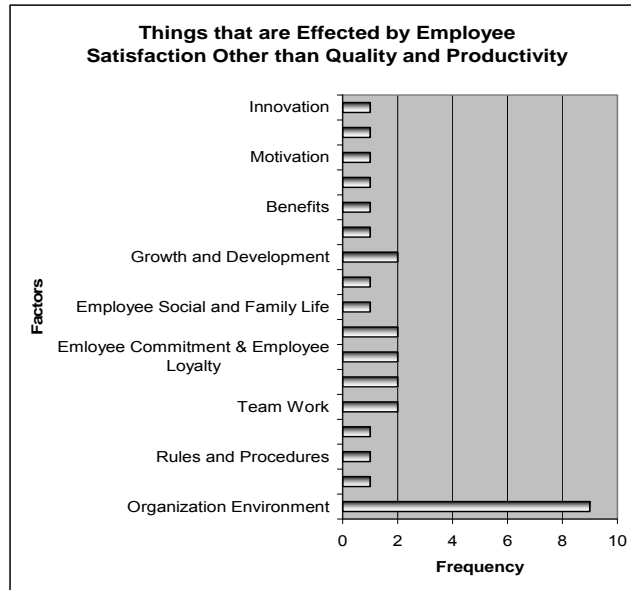
Figure (4): Simple Bar Graph for things that are affected by Employee Satisfaction

Similarly, at government (industrial), individual, managerial and social level, they should improve educational facilities, drive out fear and should undertake innovative projects (Figure 5).

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Employee Satisfaction at Organizational, Government, Managerial and Individual Level

Factors (top to bottom):
- Assignment given according to interest
- Better Communication
- Role description
- Mutual Cooperation
- Improve HR Policies
- Improvement in Socio-economic condition
- Training Benefits
- Innovative Projects
- Continuous Environment
- Career Path
- Educational Facitility
- Job Security
- Flexible Work Hours
- Supportive Environment
- Coffee Machine
- Salary
- Working Environment
- Performance appraisal
- Drive out fear
- Soft skills

Frequency (x-axis): 0 1 2 3 4 5 6 7

Figure 5: Simple Bar Graph for Suggestions from employee as what need to be done at different level in order to increase employee satisfaction.

Conclusion:

The study provides support for some key factors serving as stimulators for employee satisfaction. These factors are pay, job interest, leadership (encouragement, feedback, and performance appraisal), career growth, working environment, broadly defined job responsibility, organizational objectives and trainings. These factors if not provided, result in dissatisfaction of employees. In addition to this some new factors have been identified which were not made part of the survey initially but came across on employees feedback. These factors include government policies, transport, good innovative projects, company strength, social and economic values, political instability, natural disaster, location, vendor management, weather, and family issues. Further, it is concluded that employee satisfaction serves as a stimulus for the organizational quality and productivity. Therefore, it is proved that employee satisfaction impacts positively on software quality and productivity. In brief, if the factors highlighted are given proper consideration, the productivity and quality of organization will increase.

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Recommendations:

Pakistan is lagging behind in IT with respect to other South Asian countries particularly India. Management should be made aware about the significance of employee satisfaction, as being an input agent towards their organization's productivity and quality, which leads to competitive advantage apart from getting return on investment.

Career growth should be focused by defining career paths for an employee, within an organization, so that employees should feel secure; career wise, and can be more productive. Competitive salary packages should be given along with a better environment to work. Job assignment must be done according to employee's interest because if an employee does not like his job, he will not be able to deliver quality in his work. Trainings should be properly planned and conducted with proper evaluation of the outcomes in learning of employees and enhancement of their job skills. Learning new tools and technology provides competitive advantage to the organizations by assisting employees in quality, development and working efficiently.

Processes should be there but they should also consider the needs and satisfaction of employees in performing them, as employees are an important asset to the organization, therefore, standards should be designed in a way that shouldn't be a hindrance towards employee satisfaction and work output.

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Effect on Organizations and Quality due to Changed Employee Work Behaviors caused by Political Instability in Developing Countries
(A case study of Pakistan's ICT sector)

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Abstract:
Uplift of any country depends upon its industrial strength, while industries get booms by investors (local and foreigners). Investor keeps many factors while doing investment at any country and political stability is one of them. When ever there are instable political conditions, industries get affected by many ways and one of them is quality due to employee behavioral changes. Pakistan is also one of developing countries which got affected badly by political instability. People in Pakistan have been going through mental trauma for the last one year due to instable political conditions and suicidal bombings. They have been insecure and disturbed. The outcome of this insecurity affects the organizations growth and revenue which in turn affects the economy of the country. When ever political conditions become worst, organizations especially those having export oriented business dealing with the foreign customers, have to look carefully on the current situations. They have to introduce change in their processes and policies. An example is of Enterprise DB (which used to operate in Islamabad, Pakistan) has shifted their development office to India. The outcome of these circumstances can be unemployment and decrease in average market salary along with employee frustration.

In instable political conditions, employee is affected with respect to society as well. This results in the de-motivation, insecurity, distraction, etc. hence, affecting in quality of work, resource slippage, schedule slippages, cost over run and many more. This can create negative image on global competitive markets. Client can go for other markets like India, Israel, Malaysia, China etc where although the labor cost is high but quality and on time delivery is somehow guaranteed. Already Pakistan is considered to be in tier-3 country among the software export nations and with the political instability, Pakistan's software industry can go in further downfall. In this research paper, the study will review the effect of the political instability on employee's behaviors working in ICT sector of Pakistan and will correlate them to show their subsequent effects on organizations and quality of product.

Purpose / Objective:
The study will examine the effects of political instability on employee work behaviors within ICT Industry of Pakistan. This will lead towards the effect of the changed behaviors, initially on ICT organizations in Pakistan and then on software quality. Then suggestions will be provided for organizations to reduce these effects.

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Scope:
Our research will be limited to employees working within the ICT industry of Pakistan. Our sample will include Software houses, Telecom Organizations, Network and Securities providers and System Organizations.

Hypothesis:
ICT industry is service oriented sector where employees have direct relationship with organizational growth and software quality. When ever political instability takes place, the organizations and society becomes its victims. Employees are human as well, so any change in society (norms) and / or organizational policies have direct impact on them. Mostly the result is a negative impact on the employees work, ending up an effect on organization and may be on the quality of work/product.

Methodology / Approach:
This study is a combination of quantitative and qualitative research where the aim was to gather in –depth understanding of the employee work behavior and the reasons that govern this behavior, which is being effected by the political and security instability. Three types of questionnaire were designed in order to get feedback from professionals working in ICT sector. These questionnaires were for Managers, Quality department people and general employee respectively.

Findings:
Information Communication and Technology is a field where the employees have to put their full mental capabilities. When instable and insecure conditions arises in some country it results in employee lack of innovation, motivation, moral and ethical values while increase in frustration, job shifting / switching and even moving to other developed countries. It also results in lacking of initiative, hardworking, dedication, devotion, carefulness, creativity, efficiency, effectiveness and concentration. Organizations will be effected not only by the lack of investment and outsourced projects but also in schedule slippage, cost overrun or even discontinuity of the projects. Due to the above factors quality of work will decrease.

Originality / Value:
This paper defines the impact of political and insecure conditions in developing countries to the employees work behaviors, serving in Information Communication and Technology sector and this impact on organizations and quality.

Keywords:
Effect of Political and security instability, information communication and technology, employee work behavior, software quality, developing countries, Pakistan

Paper Type:
A conceptual paper which is a case study based on the political and security conditions of Pakistan.

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Abbreviations:

Abbreviation	Definition
PI	Political Instability (including security instability)
ICT	Information Communication and Technology

1. Introduction

This study will examine the effects of political instability on employee work behaviors within ICT Industry of Developing countries and for case study Pakistan ICT sector is studied. This will lead towards the effect of the changed behaviors, initially on ICT organizations in Pakistan and then on software quality. So in this research will try to figure out

- Effects of political instability on employee work behaviors
- Effect on organizations due to these changed behaviors
- Effect on software quality due to above effects

After doing above suggestions will be provided about ways for organizations to reduce these effects.

2. ICT Industry of Pakistan:

The ICT industry in Pakistan is in its infancy and is struggling to catch up with the regional and global industry. The IT industry of Pakistan is currently valued [1] over USD 2 billion with an IT workforce of 110,000, growing at almost 20,000 a year. There are more than 125 ISO certified and CMMI rated IT firms in Pakistan. The industry is facing a serious shortage of quality technical and marketing professionals [15] and is unable to compete its neighboring countries.

3. Data Collection Method:

For this research three forms are designed. All the data is gathered by these three survey questionnaires. Survey questionnaires were divided into the following three categories. Data was collected only from professionals and no students were targeted.

3.1. Employee Opinion:

For employee opinion, intended audience is general employee from any department but serving ICT sector of Pakistan. This is a generic form which is used for gathering data about political instability effects on employee regarding their work and behavior.

3.2. Management Opinion:

This questionnaire is designed to get management opinion about effect of political instability on employee and its subsequent effect on organization. Intended audience is managers, team leads, and higher management.

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3.3. Quality Department Opinion:

This questionnaire is designed to get quality department people opinion about effect on quality due to political instability and its effects on employee behavior. Intended audience is people working in QC, QA, QM, QI and support department.

As this research is investigatory so all above questionnaires are composed of two portions which are

1. Quantitative Portion
2. Qualitative Portion

Purposes of these surveys are to collect enough data so we can answer our research questions and their sub questions. The details of these research questions and sub questions can be found in Appendix II. After compiling results we will be able to suggest what employee, management and quality department people think about effects of political instability and how it effects organizations and quality.

4. Data Collection:

In this research overall 51 people participated from 30 organizations working in Information, Communication and Technology sector at Islamabad, Lahore, Karachi and Peshawar. More precisely 29 professionals took part in employee, 13 in management and 9 in quality department opinion survey.

5. Limitations:

Research is based on political conditions from 1st December 2006 to 1st December 2007 in Pakistan. Only major ICT cities were targeted which included Islamabad, Rawalpindi, Karachi, Lahore and Peshawar.

6. Data Analysis and Findings:

6.1. Employee Analysis:

The data suggests that although over 85% of employees are not either affiliated with any political party or taking part in political activates and having either minimal or no affiliation, yet 55% employee's interest has raised in politics due to instability which means that many of ICT sector people are concerning about politics and more then half of ICT employees are taking interest in politics now (after instability) so any condition effecting it more towards shakiness, like one of the former prime minister and lifetime chairperson of a large political party in Pakistan was killed in December 2007, will leave a rational impact on their behaviors because when ever some body takes interest in something and it gets instable it must leaves some effect on him which are mostly negative [16]. This also shows that political and security instability have effects on employee behavior which is being complimented by survey that over 65% people have gone some change in their work style due to these conditions. In excess of 72% people are facing fear and insecurity feelings. Nearly 72% employees feel that their motivational level has changed and out of them 81% feels that this change is negative. When some one is de-motivated and also facing fear then it is extremely difficult for him/her to concentrate on work which may lead towards producing lack of quality work or even no

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useful work. Regarding ethical behaviors 50% employee feel change and out of these 66% feels a negative change which is not a good thing in a civilized human society/organization ethical behaviors should be moving upwards not falling downwards. Over 50% ICT sector employees are dealing with overseas customers and more then 60% think that their behavior with employee has changed so this political instability definitely have impacted on organizations dealing with foreign projects. A huge portion of 89% employee feel mental stress and one can easily say that this mental stress will have a negative impact on organizational productivity and software quality because software is considered as a game of mind. When mind is in trauma game will disturb. Nearly 83% ICT sector professionals surveyed feel life and job insecurity which tells that IT sector is facing problems like lack of revenue, growth etc which can lead in future towards downsizing . This already has been done in some multinational organizations which have shifted their offices to other countries in the region. Majority of people (89%) wants to remain in IT sector even though this instability remains in the country. 82% people responded that after instability employees are spending more time in political discussions at offices while in excess of 50% people face such situation when they wanted to come office but law enforcing agencies have not allowed them, more then 50% notified that they have some important task like project deadline or customer meeting scheduled at that day when they can't reach offices, if these conditions were stable then this time would be invested in work related activates which will result in better productivity. Now these things are not good for organizations at all as when deadlines or important customer meetings are postponed it may result in schedule slippage, cost overrun and to catch-up up these two things quality will be disturbed or even in contracts cancellation. 96% professional agreed that foreign investment would be much higher (in terms of revenue, out sourcing projects, call centers, communication networks, jobs etc) in Pakistani ICT sector if these political situations would be better also in that case there will be more job opportunities and according to supply and demand rule average salary packages would be much higher.. It is facts that before operating in any country organizations do SWOT, PEST [18, 19] analysis. In PEST political conditions are directly examined while doing SWOT analysis political instability is weakness and also a major threat to business. Intra team's communication is a necessary factor in ICT sector while according to survey 57% people believe that due to conflicts in political opinions this communication can suffer. 62% respondents consider that documentation, 48% agreed on attendance sheets and time card marking, 35% think that client meetings, 51% voted for improper check in and check outs, 42% opted in favor of lack in requirements gathering while 60% suggest that break timings have suffered due to political instable conditions.

89% respondents notified that there is no change in their working hours due to instability but in the same time majority commented that they are facing situations where they are not allowed or they can't reach office due to instability. 42% think that they will not compromise on quality even if it takes more time. This means that time has lost but organizations are not forcing employee to work for extra hours also which can cause schedule slippage. In instable conditions business can lack down [16 , 18] which will effect average pay scale, according to survey 62% people supported that it will decrease while only 3% voted for increase.

Employees do share their views about the circumstances happening around them and this is wastage of time. When they share their views they also think on other's views as well so the cumulative time is much higher. The maximum difference between time spent in political discussion before and after instability is 80 minutes (which is quite high) while minimum time is in negative which shows that people were talking about politics earlier but when they saw instability they were so de-motivated that they tried to talk less. Psychologists suggest that when ever some one seems things regularly he tries to ignore them. The same situation applies to these few employees who have reduced their discussion time in politics. Average time variation recorded is 19.82 Minutes. Employees are spending up to 90 minutes at office which is quite huge.

6.2. Management Analysis:

Data shows that nearly 85% mangers agreed that their customers are concerned with political instability; some even suggest that when ever they talk to customers (especially foreign) the first thing they talk about is instability and schedule. Pakistan ICT industry is already lack of qualified resources therefore there is no downsizing going on and 100% managers agreed on this. Yet 75% managers reported about lack of new job openings due to these conditions. Also mostly managers (75%) agreed that there is no change in average salary package. When we observe overall some organizations even do downsizing like E-DB, DRL etc but experienced employee get job quickly due to human resource shortage. Only 23% respondents agreed on resource slippage due to political instability. As we can infer from employee analysis that time has been wasted in different forms thus over 61% managers voted about facing schedule slippage. 75% Managers think that employees are spending more time in political talks, discussions, news readings etc than before. 61% manager's important task regarding project or customer meeting has been affected due to instable conditions. Manager to subordinate communication also disturbed as 75% managers agreed on this.

When organizations are trying to maintain their image they are also starving to deliver things on time, this has been inferred from 72% manager's first choice to deliver on time rather concentrating on quality. 75% managers opted for no change in their working hours.

Like employees, managers also engaged in political discussions during office timings. Difference between "before and after (during)" instability ranges from 0 to 40 minutes, averaging 18.8 minutes. Now they are spending up to 60 minutes at office.

6.3. Quality Department Analysis:

Quality department work is the most import in ICT organization. If these people face disturbances then one say that work product quality will directly suffer. According to data collected 100% responded that political instability has affected their important task, deadline or customer meeting. It clearly states that quality has endured due to political and security instable conditions. 77% realized that "new" and "not fixed" bug's ratio has increased while over 62% favored in the change of releases and build schedule in such conditions. Normally client is not so much conscious about quality yet it has been observed that nearly 55% responded that their client has concerns relating quality due to

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employee changed behaviors. One good thing is that approximately 78% quality professionals suggest that the conflicts due to variant political opinion is not effecting intra department communication, which may result that processes within quality departments are stronger then other departments, yet 55% voted that quality has disturbed due to lack of communication. Results of question 14 (a – p) reflects that software understandability, completeness, conciseness, consistency, maintainability, testability, Structuredness, efficiency, proper documentation and internal requirements gathering has affected while self explanatory coding and taking backups may have affects.

Quality department also realizes that in case of pressure situation 62% will prefer to deliver on time rather taking more time and focusing enhancement of quality. 66% think that changed behavior has strong effect on employee queries, complaints and satisfaction level while 55% believe that average pay scale can decrease in such circumstances.

Like employees and managers quality professionals also been spending time in political discussions. Maximum change in political discussions before and after/during instability is 35 minutes, minimum 10 minutes while averaging 22 minutes. Now they are spending 15 to 60 minutes in political discussions at office.

6.4. Changes in Employee work behaviors due to P.I. (Political Instability):
As shown in analysis interest rate in politics is increasing and employees are talking about politics within office timings. They are wasting more time discussing the uncertainty, gossip and related versions of the stories. Newspapers, news websites and news channels are being discussed almost round the clock. The focus on work and projects has decreased. Team work and communication has disturbed. Their attention form work has deviated and if the brain is not there it means that there is no point working in a team or individually.

Country is facing worst conditions regarding security. According to BBC 57 suicidal attacks hit the nation in different cities with in one year taking hundreds of lives. Lowest ratio of blasts was in Lahore where ICT sector employees have less insecure feelings then other cities. Survey suggest that employees working in ICT sector of Islamabad Rawalpindi, Peshawar and Karachi are very much scared and feeling insecurity. They want physical on job security and security of their belongings. It also put employees in some mental distortion and stress; moreover tense mind can never give perfect results. Professionals are facing lack of concentration on work. P.I. has deceased moral, motivation and interest in their work which is badly affecting schedule; number of bugs produced are increasing etc.

Professionals are thinking about second nationality of any first world nation or at least getting immigration. Pakistani ICT sector is already facing lack of qualified resources and when cream will move out of the country, it will create a huge shortage of qualified resources as majority educational institutions are not able to produce trained human resource which can immediately be integrated in professional environment.

People dealing with foreign customer are under fear for job and project insecurity (Digital Research Lab faced this situation) as foreign customers do have other options in

the region. This P.I. already has affected Pakistan ICT sector in terms of less number of outsourcing projects and revenue / offices shift to other regions. Like Microsoft has opened their development office in India even where labor cost is higher than Pakistan. The only attraction they have is political and security instability. It never happened that army rules over the civilian government and announces any form of marshal law.

These conditions forced employees to start thinking about the IT future in Pakistan. It is a fact [16, 18] that when ever political and security conditions become worst in a country it affects all the industries in that legion. The same goes with ICT. Currently they are many organizations in this sector which are either foreign based organizations or working on outsourced projects from other nations. It includes Telecom, IT, Call centers etc. When P.I. conditions will fall, these will move to any other part of the region. We are already in tier 3 nations in software production. If conditions were not improved, professionals will start thinking about their future. Over 52% respondents agreed that pay scale in ICT sector can decease (may be due to lack of projects, decrease in revenue or growth) which is another important factor regarding employee de-motivation.

6.5. Effects of changed behavior on organization:
Organizations remains close for some days and employees may leave early when there is instable conditions which results in heavy work burden for catching up schedule. Survey data shows that mostly organizations are not opting for extra work hours. This can lead to schedule slippage. Employees are also reluctant to go outside for data gathering and troubleshooting problems. Security concerns make people less motivated which results lack [20] in initiative, hardworking, dedication, devotion, carefulness, creativity, efficiency, effectiveness and concentration. In instable conditions a reasonably good margin of employees thinks more about themselves? What will happen? What is going on? Who is Responsible? And not thinking about work? What am I doing and what remains next in office? Changed behaviors also negatively impacted productivity which results in loss of revenue / profit but this is out of this research scope. Majority of respondents agreed upon change in their deadlines and also disturbances to meetings with clients. Employee dealing with customer has affected which can result in discontinuity of projects or even after completing this project cline may not grant any further contract to organization. Enough office time is being wasted in political discussions. Break timings are misused. In general organizations are lacking due to changed behavior in providing quality of service to internal and external customers

6.6. Effects of changed behavior on quality:
Employee changed behaviors due to P.I. creates problem to accomplish all the quality related tasks in the given time
1. So therefore one has to either compromise over quality or
2. Shall need more time to ensure quality, also
3. It disturbs the flow of working of a department

An ICT client has normally three perspectives time, cost and quality. From data collected it has been proved that organizations did faced wastage of time, yet management and quality department majority likes to deliver work products on time. Now if they increase

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cost it will have immediate bad effect and client may cancels contract. In this scenario it can be inferred that quality will get disturbed.

It creates harassment among people in a way that it encapsulates the people and they care more about themselves and their families rather than their work which can cause lacking in PPQA, auditing and also can face problem in quality implementation due to stressed behavior of other employees. One factor is that during exploratory testing, testers cannot really concentrate while thinking of what is going around in an unsettled society. I feel that this instability results in lack of an effective testing. Client is now more concerned with software quality. Due to the changed behaviors organizations are facing difficulty in running processes and it is extremely difficult for small and medium organizations to work on process improvement. Survey results suggests about effect on increase of bugs (new and rejected) which suggest developers lack of focus, inter teams communication and can have negative effects on software understandability, completeness, conciseness, consistency, maintainability, testability, structured ness, efficiency, proper documentation and requirements gathering.

6.7. Effect of political instability on different cities:
Regarding survey results Islamabad, Karachi, Rawalpindi and Peshawar were affected more then Lahore. Lahore seems to be politically and security wise stable that's why professionals working there got less affects.

7. Recommendations:

7.1. What organizations can do to over come these effects on employee:
It is necessary for organizations to take immediate actions to reduce P.I. effects on their employees, this will be beneficial for organizations work progress and increasing quality of service and work products. Actions needed by organizations can be summarized as (not in priority order)

1. The Management should tell the employees about the importance of their projects and impacts incase if the company not deliver the project at time what are the intricacy face by the company in future and on the employee's job security.
2. Provide some kind of recreational activities (if possible) such that indoor games, LAN games, recreational trips, outdoor tournaments, get together parties.
3. Provide employee job security by telling them that nothing will happen with respect to job provided that they concentrate on work.
4. Provide employee physical security and also can provide life / medical insurance. Do strictly examine the people entering the organization. People feel motivated when they see organization is taking concerns relating them. Organizations have to adapt the safety first policy and then organization.
5. Motivate employees to handle these Political instable conditions like guiding, empowering, training and involving them
6. Try to create such atmosphere to show that there is nothing happened with respect to organization and work.

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7. Provide such environment where people can work from homes in case of any instability. For example Elixir Technologies is trying to arrange a set up (nearly done) where employees can perform their duties at home in spite of coming to office when the conditions were not stable enough for them to reach office.

8. The organizations can pressurize government to follow the paths of democracy through their associations like PASHA (Pakistan Software Housing Authority) etc. and must encourage the democratic thoughts within their organizations. This will fulfill dual purposes. First employees will be motivated that organization is taking care and secondly organization good will be increased in the customer eye.

9. Organization should make client dependent on them rather then depending on clients. Its very difficult but can achieve by producing quality products like TeraData or by having proper process institutionalizations. Best way to do this is achieving CMMI appraisal which results in improved processes and hence product quality will be improved. By this way we can make our products so strong that client has no way to escape, this will give confidence to our employee.

10. Organization can work on products so that employees can work with out client pressure until the product is released. Limitation is that very few organizations in Pakistan can invest on products and wait for revenue generation till it has been launched. Best way is to do project and products simultaneously where employee are a bit satisfied that incase of projects failure organization can shift them to product. Example organization for this strategy is InterActive Communications which other then doing above also avoid short term projects and focus on long term projects.

11. Management should avoid talking about politics and focus on increasing communication relating work.

12. Organizations can have a department to deal such issues like at Mobilink they have security department which always remains in touch with employee. Another example can be like one of the InterActive's clients at Karachi needed some technical professionals for troubleshooting while the conditions were not stable there due to blast in receptive gathering of a foreign prime minister of Pakistan. Interactive management consulted their security advisors and on their recommendations they took decision of not to send their technical people there and waited until situation gets better. These kinds of decision increases employee motivation, loyalty and sincerity.

13. Do better HR management, one form can be by applying internationally accepted employee related rules and regulations.

14. Make proactive organization strategies like must care political instable conditions while doing planning, estimation, scheduling etc also perform risk analysis more carefully.

15. Realize employees that company is stable and growing.

7.2. What employees can do to reduce these effects:
Employees working on foreign projects have to show like there is nothing will be happening to their customer, they have to be more careful about deadlines (for this they may have to work extra hours). This will result in restoring image. If they can satisfy their customers or management which are sitting abroad they certainly will get business

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and revenue. Try to have minimal effect on the projects and build the positive image of the country to the outsiders even in these conditions.

8. Conclusion:

This instability is occurring consistently and new and newer incident creates more and more depression. Pakistan is also in the category of Iraq and Afghanistan [10], the only difference is that people there are fighting against other countries army while here they are fighting against their own countries law enforcing agencies. Situation may not heal up quickly and it will continue effecting employee work behaviors and increasing their frustration, insecurity while decreasing their moral and motivation. This all will affect organizations and quality. To get through positively with minimal negative effect in these situations organizations have to play their rule other wise conditions may become worst.

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Requirements on document management systems – recorded using the Analytic Hierarchy Process and transferred into a Quality Function Deployment

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Abstract
By using the Analytic Hierarchy Process [AHP] the precision of the weightings of customer demands can be increased before they are used in a Quality Function Deployment [QFD]. Basically essential are the method of pairwise comparison as well as the assessment of the logic. A problem for a QFD-integration is that the AHP gives relative weightings. Therefore we have created a way of transferring relative into absolute weightings. The complete procedure was successfully realised in a document management-systems [DMS].

Originality/value
One possible methodology to apply AHP before a QFD was presented at the QMOD 2007. Now we have developed this procedure further and have tested it in practice in the prioritization of demands on DM-systems. Additionally, we have tested various methods of transforming the relative into absolute values in order to increase precision.

Purpose
QFD can only lead to exact results if the input mirrors exactly the customers' opinions. The relative weightings won by the AHP certainly represent the preferences more exactly. The next task was to transform these relative weightings in such a way that they can be entered as input into a QFD. On the one hand, this procedure has to be practicable, but on the other hand the loss of precision has to be as small as possible.

Methodology/approach
We have therefore developed a methodology how to transform the relative weightings of the AHP into absolute weightings for a QFD. The suitability of the concept was tested in several customer interviews and the results were processed according to the methodology. The resulting customer requirements can be used to support a concrete

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investment decision as well as by developers for new or further development of DM-systems.

Findings

When tested we have found out that the interviews with the help of AHP are accepted very well by customers. We had expected some difficulties concerning the consistency of the answers. However, this was not the case. The procedure was considered very practicable. Furthermore, the precision of the input of the QFD could be increased.

Keywords: QFD, AHP, customer requirements, relative weighting

Paper Type: Research Paper

Introduction

By using the Analytic Hierarchy Process [AHP] the precision of the weightings of customer demands can be increased before they are transferred into a Quality Function Deployment [QFD]. This method used to develop products and services with a view to the customer can only lead to exact results if the input mirrors exactly the customers' opinions. The prioritisation of all QFD parameters on the basis of an absolute evaluation process is deemed currently to be standard. However, as this process does not permit any differentiated evaluation, the significance of the results can only be estimated with some difficulty. The relative weightings won by the AHP certainly represent the preferences more exactly which is mainly based on the hierarchical structuring and pair-wise comparison of all input parameters as well as the assessment of the logic of the weightings.

During the course of a project dealing with the ascertainment, structuring and weighting of demands of an intra-logistical plant, the AHP was successfully employed in 2007 (Crostack, 2007).

Based on evaluations of the requirements made on a Document Management System [DMS], the practical suitability of the method for prioritising customer requirements was to be more thoroughly investigated by using a higher number of surveys.

Additionally, we had to find a way of transforming these relative weightings so that they could be used in a current approach to QFD - for example, in line with the American Supplier Institute [ASI]. On the one hand, this procedure has to be practicable, but on the other hand, the loss of precision has to be as small as possible. The resulting customer requirements can be used to support a concrete investment decision as well as by developers for new or further development of DMS.

Fundamentals

Analytic Hierarchy Process

The AHP is a method developed by Dr. Thomas Saaty to support decision-making where problem-solving involves taking a host of criteria into consideration. Ascertainment and hierarchical structuring of relevant parameters are characteristic as is a level-specific evaluation of criteria and alternatives in paired comparisons. The evaluation of individual

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paired comparisons resulted in local and global percentages which allow parameters to be ranked. Furthermore, on the basis of the ratio scale used in the evaluation process it was possible to interpret intervals between the element-specific weightings and thus precise statements could be derived from the evaluator's preferences. Furthermore, the AHP provides a theory for checking the inconsistency. It is thus possible to estimate the logics of a partial decision as well as to make a statement on the quality of the overall results (Saaty, 1990).

The AHP is divided up into three phases and a total of eight sequential steps. A brief example allows the most important process steps to be followed.

Modelling	Evaluating	Validating
• Goal-setting	• Criteria	• Consistency check
• Definition of parameters	• Alternatives	• (Sensitivity analysis)
• Hierarchy design	• Summary of results	
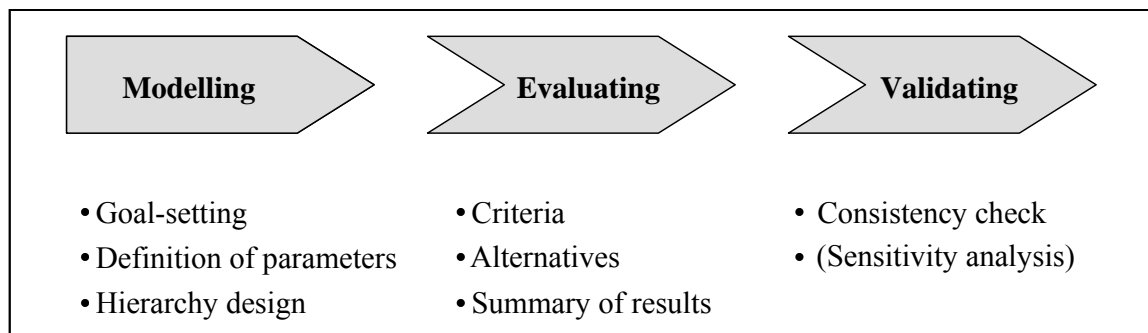
Figure 1: Diagram of AHP steps

This example aims to illustrate customer requirements regarding a travel hairdryer whereby it deals with a pure weighting of criteria which maybe supplemented at any time by an evaluation of an alternative. The criteria under observation and integration into a hierarchical structure can be seen in the following diagram. If several alternatives were to be observed at a later time, then the decision hierarchy would have to be supplemented by a third level.
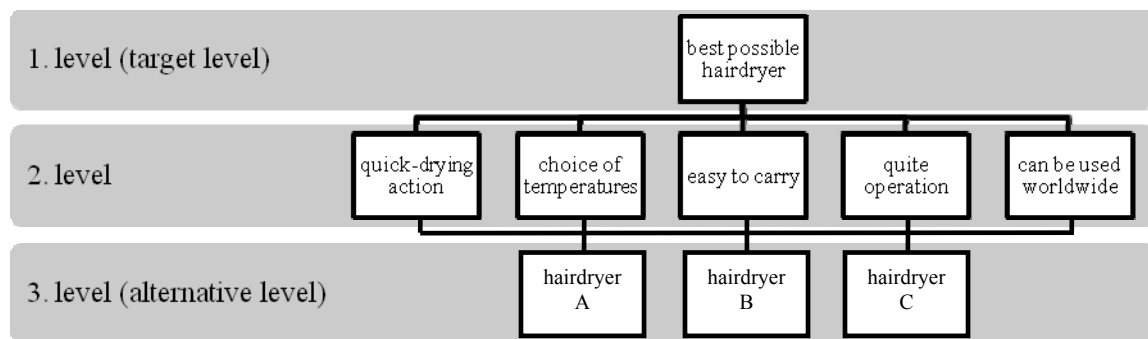
Figure 2: Hierarchy for weighting of requirements on a travel hairdryer

In order to solve the above decision-making problem, all of the criteria involved in the target must be compared in pairs with one another. This requires a total of ten individual evaluations.
A metric scale was employed for the weighting which contained all the numbers between 1 and 9 as well as their associated reciprocal value. For example, 1 stands for equally

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important and 9 for the largest difference in significance between to compared comparisons.

The results of a partial decision are recorded in matrix notation. The following values are assumed in evaluating requirements on a travel hairdryer.
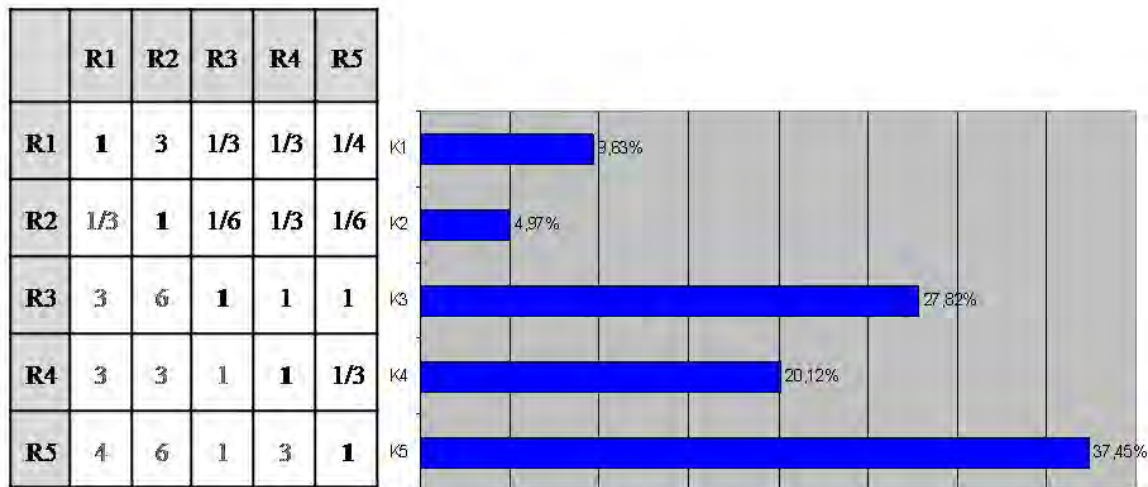
Figure 3: Criteria priorities matrix and criteria priorities

Accordingly, for example, R1 is somewhat more important than R2, however somewhat less preferred than R3, R4 und R5. The other lines may by interpreted using the same schema. All of the element-specific preferences may now be derived from the above matrix. Saaty was able to prove mathematically that the associated inherent vector matrix represents the relative weightings of the compared elements.

This may be attributed to the characteristics of the priorities matrix:

- All of the diagonal elements show the value 1
- The diagonal serves as a reciprocal axis of reflection
- The number of lines and columns is identical and agrees with the number of elements compared

The relative weights gained by determining the eigenvector are as follows for the example given: EV = [0.0963,0.0497,0.2782,0.2012,0.3754]T. The above bar chart was created on the basis of these values and clearly shows the relationship between individual criteria. For example R5 = 4 R1. Verbally, R1 is thus less important than R5.

In addition to the classical scale evaluation of criteria and alternatives, it is also possible to standardise individual values to 100% by integrating quantitative values directly. This would lend itself, for example, if the noise level of various travel hairdryers were to be compared with one another.
If the basic decision-making problem is structured so that the decision-making hierarchy has more than two levels, the results of individual decisions must be consolidated.

Viewed formally, all of the local eigenvectors at level n + 1 are summarised into one matrix and multiplied by the respective eigenvector of level n. This results in a consolidated vector which in turn must be multiplied by the vectors of levels n + 2 which have been consolidated into one matrix. This algorithm is repeated until the consolidated vector for the lowest level which represents the desired final result has been determined.

In order to determine the logics of a concluded partial decision, the so-called Consistency Ratio [C.R.] is determined. In the example, this is 4% and thus clearly below the threshold value of 10% as required by Saaty. Man's cognitive skills limit his ability to make consistent decisions - a low degree of inconsistency must consequently be permissible. The larger the number of paired comparisons, the more difficult it becomes for the evaluator to place weightings logically. A survey carried out by the US American psychologist, George Miller, showed that man is not able to consider more than five to nine items of information at the same time (Miller, 1956). An important ruling for the hierarchical design is derived from these findings – i.e. for each partial decision not more than seven parameters should be taken into consideration.

In comparison to absolute evaluation methods in the run-up to QFD, AHP displays numerous advantages. The set-up of the evaluation techniques ensures that the observed customer requirements are independent of one another and meet the same dimensions. Furthermore, the interviewee is forced to make a differentiated weighting as contradictory evaluations are revealed by a high inconsistency factor. Moreover, not only can the intervals between the individual preferences be interpreted but also their relationships can be interpreted and a sensitivity analysis can be carried out.
The drawback is that weighting via AHP is considerably more time-consuming and requires a higher concentration as does an absolute evaluation procedure. As to how far this has an effect on the motivation of the interviewee was looked at during individual questioning and is explained at the end of the concept description.

DMS
The Document Management Software is digitalised for database-supported administration and electronically generated documents are used. The exclusive administration of scanned records is known as document imaging. Solutions which administrate scanned and original digitally generated data are being increasingly sold under the term Documented Related Technologies [DRT]. If the system comprises all structured and unstructured documents of a company, it is usually referred to as Enterprise Content Management.

The functional scope and focus of DMS may vary considerably depending on the producer and the number of acquired software modules. The following diagram shows the typical life-cycle of a document. All of the phases shown here can be supported using a DMS.
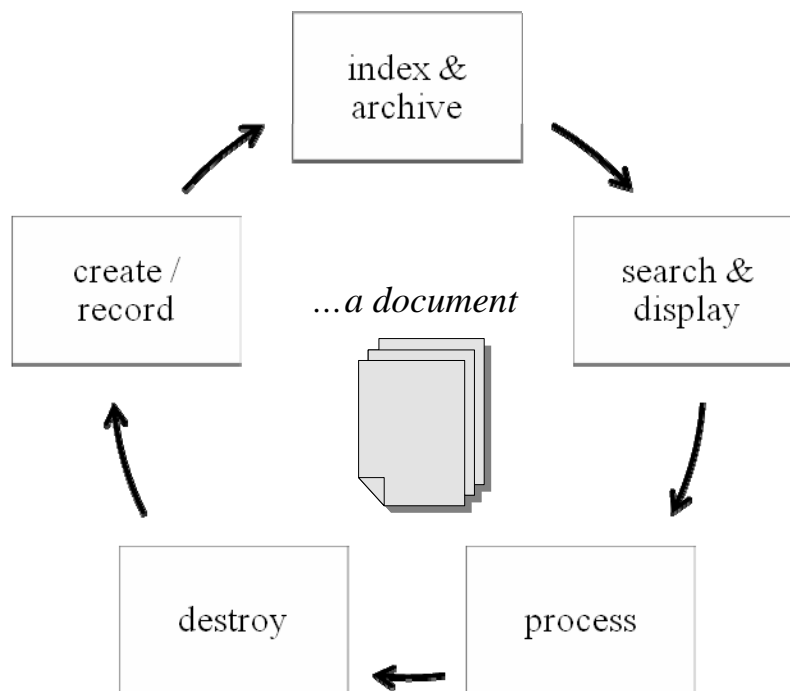
Figure 4: Document life-cycle

The cycle begins with the creation of an internal document or the recording of an external document. Analogue documents must first be digitalised so that they may be administrated by means of a DMS. Before archiving, features which clearly identify the document in question must be noted. This type of indexing allows the archived documents to be retrieved and displayed at any time. Using the processing function documents may for example, be amended, passed on or copied. Processing and the destruction of documents both depend on User Rights and the type of document. The procedural steps Search and Display as well as single processing functions can be carried out in reverse order and as often as required. If wanted, the documents can be automatically deleted on a previously defined date.

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Costs for storage, internal and external transport, printing and copying of documents can be drastically reduced by the continuous employment of a DMS. Furthermore, there are also other advantages which cannot be immediately quantified - such as increased ability to provide information to internal and external customers. Because of the long procurement and introductory phases, additional costs incurred for hardware and high training expenses DM solutions are currently found mostly in larger enterprises and organisations.

These incurred costs however are not the only reason why many decision-makers in medium-sized companies hesitate. Those responsible often have neither the necessary expertise nor the time to carry out consistent project planning parallel to their daily business activities. In addition to testing AHP, the following in-depth discussed concept aims also at creating a qualified requirements profile. Additionally, the consolidated individual results may be used for customer-directed (advanced) development of DM software for SMEs.

Concept on structuring and weighting of customer requirements by means of AHP
The concept of prioritising requirements using an AHP is broken down into a total of eight steps as can be seen in the following diagram. All customer-specific components are shown against a grey background. The first two and the last process steps are in contrast carried out just once, independent of the number of interviews. The individual concept phases are explained in more detail, as follows.
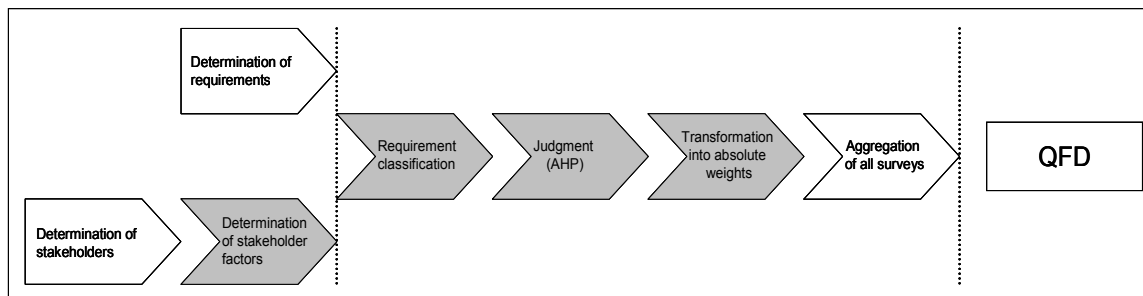
Figure 5: Process of requirement-structuring and weighting

Determination of customer requirements on a DMS
The requirements catalogue on whose basis individual customer interviews are carried out comprises a total of 65 requirements which have been determined through comprehensive research in professional literature, journals, investigations and guidelines, as well as product descriptions. Thirteen types and four super-ordinate subject blocks have been allocated to the individual requirements. The following table illustrates the structural set-up of the catalogue.

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Table 1: Breakdown of requirements on a DM software

Block A	*General*	A1	User-friendliness
		A2	Qualification of software producer
		A3	Service
Block B	*Technical properties*	B1	Flexibility
		B2	Safety
		B3	Capacity
		B4	System performance
Bloc C	*Functionality*	C1	Recording and indexing
		C2	Research
		C3	Advertisement
		C4	Processing
		C5	Administration
Block D	*Cost-efficiency*	D1	Total costs

The list comprises only such requirements which do not represent a compulsory K.O. criterion, but which can likewise be estimated as being relatively important or absolutely unimportant. Requirements which, for example, must be archived in accordance with legal provisions have consequently not been taken into consideration.

Furthermore, only the contents of those criteria are observed which refer to the above-named basic functionality of DMS. As the interviewees are potential customers, the requirements focus is on classical systems. For the same reason, the majority of problems dealt with were user-related. Requirements made on storage media, scanners, monitors, printers and other peripheral devices were not taken into consideration as they do not have a direct connection to concrete software solutions.

Determination of stakeholders and associated factors

Persons with a justified interest in the activities of an institution or enterprise are referred to as stakeholders. The requirements of stakeholders depend on the respective perspectives. The following stakeholder groups were included in the DMS survey:

- *Management (S1)*
  - ➢ Stakeholders who take decisions on the implementation of a project from a commercial perspective
- *IT experts (S2)*
  - ➢ Stakeholders who take decisions on the implementation of a project from a technical perspective and/or take on the administration of software ,
- *Users (S3)*
  - ➢ Stakeholders who use the software in their daily business life

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Depending on the preference of the person responsible different weighting factors can be allocated to individual stakeholders. These may be globally defined or can vary according to requirement block and requirement type. Basically, this can be all absolute and relative evaluating procedures e.g. also AHP.

Stakeholder-related classification of requirements

The weighting of requirements is broken down into two steps. It must first be clarified whether the requirement is absolutely important, merely advantageous or absolutely unimportant from the point of view of the evaluator. This classification alone ensures that the requirements assessed using AHP have a comparable dimension. Must-have requirements are so significant, that it is absolutely unacceptable that they are not met. Can-have requirements are also beneficial for the customer and must be specified in more detail in a second step using AHP. Meeting an absolutely unimportant requirement however does not provide the customer with any additional benefit and is thus not acknowledged. All of the criteria thus affected can be therefore deleted from the requirements catalogue. As several stakeholders are involved in the evaluation the weighted average is taken to determine the overall classification of a requirement. The following applies:

$$a_i = W_{i,1} * g_{i,1} + W_{i,2} * g_{i,2} + \ldots + W_{i,n} * g_{i,n}$$

// a_i: requirement i, W_i: requirement-related stakeholder weighting; g_i: stakeholder factor

Hierarchisation and relative weighting of can-have requirements

All requirements which have been classified as advantageous can now be weighted using AHP. Hierarchisation picks up the breakdown in the requirements catalogue. Blocks A to C are integrated on the second level i.e. below the objectives. The requirement types are shown on the third level. Which criteria flow is incorporated in the fourth level depends on the concrete results of the requirements classification and is thus variable.

An AHP software is recommended for customer evaluation as this allows a simultaneous evaluation of results and determination of inconsistencies. For example, ExpertChoice could be considered – a US American software solution, developed in direct cooperation with Saaty (ExpertChoice, 2008).

As was the case for requirements classification, the AHP weightings of individual participants must be aggregated to give an overall result whereby the stakeholder factors in each case should be taken into account. Again, the weighted arithmetical average is used to consolidate the stakeholder-related weighting. Global priorities are calculated by multiplying the consolidated local values with the global weight of the superordinate criterion in each case. The use of a spread sheet analysis programme is recommended should the AHP software not support direct stakeholder integration and factor definition.

If in relation to a requirement type only one requirement is defined as advantageous, its benefits cannot be determined by means of AHP. As it is not possible to carry out a paired comparison, the absolute weight must be ascertained using an absolute evaluation method.

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<u>Conversion of relative to absolute weights</u>
In order to be able to use the QFD strategy in accordance with ASI, the relative weightings must be converted into absolute figures. All requirements which have been declared as absolutely essential and absolutely negligible in the classification can be integrated directly into a QFD. As for the nine-element evaluation scale for the can-have requirements, all must-have requirements should be allocated the value 10 and all unimportant criteria the value 0.

The priorities of the can-have requirements determined by means of AHP are present in the form of relative numbers because of the method used. In order to obtain a uniform evaluation profile, these numbers must now be allocated into figures from 1 to 9. The person responsible must decide whether in principle the highest relative priority is to be automatically given the number 9 or whether the absolute priority is explicitly asked for.

Furthermore, the mathematical link existing between the relative and the absolute values must be determined. A linear relationship is one possible strategy which could be picked up for the customer surveys. The absolute values in the fourth column apply to the above example.

Table II: Variants for transforming relative into absolute values

Requirements	Relative values	Factor analysis		Absolute. values V1		Absolute values V2
R5	37.54%	1		9		9
R3	27.82%	1		7		9
R4	20.12%	2		5		8
R1	9.63%	4		2		6
R2	4.97%	8		1		2

The following formula was used in calculation. Mathematically, it is standard on the highest reading of 9.

$$a_i = \frac{w_i * W_{max}}{w_{max}} \qquad // \ w_{max} = 37.54 \ \% \ \text{und} \ W_{max} = 9$$

The AHP permits a verbal interpretation of the intervals between individual priorities. If the most important criterion (R5) is set in relationship with all of the criteria weightings, this will result in the factors listed in the third column in the above Table. It thus emerges that R5 is just as important as R3 and a little more important than R4. Furthermore, it can be seen that R5 is more important than R1 and significantly more important than R2. In relationship to the AHP interpretation, the differences between the first three absolute values is the most strikingly clear factor.

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If a customer had directly weighted a requirement as absolute and would be of the opinion that R5 is only a little more important than R4, he might have selected the 8 or the 7 instead of the 5. The question therefore arises as to how suitable a linear distribution is for converting relative priorities into absolute priorities.

Another possibility is to determine the absolute values by means of a factors analysis. The conversion table on whose basis the absolute values in the last column of the above Table were determined are shown as follows:

Table III: Factor-based conversion table

Factor differences	1	2	3	4	5	6	7	8	9
Absolute values	9	8	7	6	5	4	3	2	1

A graphical comparison in comparison with an ideal typical linear curve is shown in the next Figure and results in an interpolation of interfaces between the relative and absolute values from R1 to R5. The slight deviations in the first variant from the linear curve can be attributed to the figures having been rounded off to whole numbers.
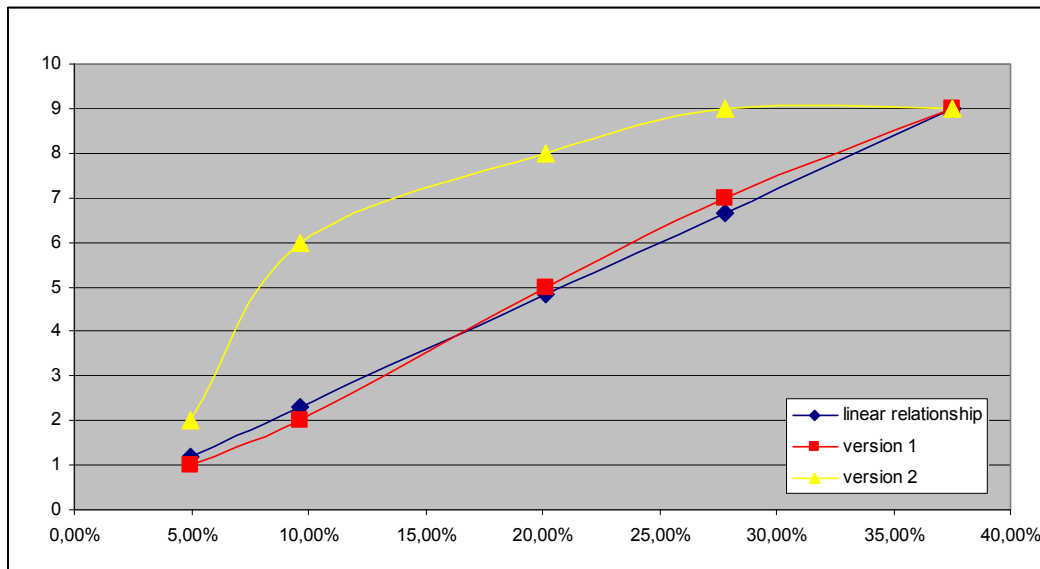
Fig. 6: Variants for converting relative scale values into absolute scale values

The first variant is used for evaluating individual customer surveys as the calculation steps can be easily automated and the second variant cannot be universally applied. When scales comprise fewer than 9 elements it would be possible to make conversions in accordance with the above schema, for example. Other conversion procedures are currently being investigated by the Chair for Quality Management, which reflect as real a connection as possible between the relative and the absolute weightings in order to minimize loss of accuracy incurred by the transformation.

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Results of AHP interviews

Peculiarities of individual results
During the course of a survey, 5 interviews each with 3 stakeholders were carried out in accordance with the previously described schema whereby various sectors and corporate sizes were deliberately addressed in order to investigate whether different parameters are reflected in diverging requirement profiles. In detail the interviews involved a forwarding company (C1), a trading company / service providers (C2), a Catholic day care and educational centre (C3), a tax consultancy / solicitors chambers (C4) and a non-profit and independent professional association (C5). All the customer surveys followed the classical flowchart. In the case of C2, the interview was additionally carried out in a team in order to investigate the impact of the method on the end results.

What is noticeable is the fact that the stakeholder weightings determined by those responsible differed greatly. One preferred in principle the dominance of a stakeholder such as the perspectives of the management. Others distinguished between the competences of those involved. Again others allocated all stakeholders the same weight. In addition, the possibility of determining various weightings depending on the requirement type was also perceived.

Regarding the deviation rate, individual surveys diverged in many ways. The evaluation showed that regarding requirement classification, differences for C5 of approximately 50% were the lowest, and with approximately 80% the highest for C1. C1 also displays the highest level of deviation in the AHP survey where 60% of relative weightings deviate by more than 0.2 from each other. In comparison, divergences of smaller than or equal to 0.2% were determined for more than 80% in the case of C4.

Where deviations were very high, those participating were advised to repeat their decisions as a team in order to find a common consensus as the average value in this case is only limitedly significant.

Although AHP was unknown to all of the participants, an open and uncomplicated handling of the method was observed. This was reflected in the inconsistency values which on the whole were very small. In all, 165 partial interviews were carried out, three quarters of which were concluded with 0% inconsistency. An inconsistency of between 10% and 20% was only observed in just about 5% of partial decisions.
Most notably, it was seen that the participants were well able to handle a high number of paired comparisons – something which because of the required level of concentration was not thought possible. The two-part set-up of the survey (requirement classification and AHP evaluation) was well received by the participants and did not lead to any flagging in motivation in the second part of the survey.

It was noted in the C2 team survey that it could be carried out considerably more quickly than the individual interviews. The discussions were very lively and constructive, although not uniformly distributed. As those responsible said, this was not because of the hierarchical differences between the participants but was due to the general divergences in a willingness to communicate. This clearly shows how important it is in these survey

variants to select a suitable team. On the whole, the level of agreement was notably high so that the moderator needed only to put forward a few proposals in the matter of compromise.

A comparison of the results of both survey variants clearly shows that in the second method, considerably more requirements were declared as being absolutely essential. In the AHP survey, slight differences were likewise determined but did not allow any tendencies to be derived. In all, the end result of 57% agreed completely. Only one of the requirements was evaluated totally differently. All of the participants agreed that group decisions should be used as a basis for possible selection decisions as these reflect better the needs of a company than the consolidated overall results from the first variant.

Overall results

As previously described the results of all the individual interviews were consolidated to one overall result. If this is done using arithmetical mean values, a tendency to higher scale values is noted. None of the requirements is absolutely unimportant according to this evaluation. In view of a differentiation strategy, the small overall number of low weightings is however of little benefit for software development.

However, the differences between individual weightings which in part were considerable are not surprising in view of the varying motivation regarding the introduction of a DMS. A cluster analysis should show whether consolidation of results from customers with similar prerequisites provide a different picture or not.

On the basis of the company or organisation size, the number of locations, the type and volume of documents to be administrated, the business process and similar comparison criteria it may be assumed that C1 and C5 as well as C2 and C4 would need to require mainly the same things of a DMS. If the average deviation between two customers is determined, it can however be seen that C4 and C5, C3 and C5 as well as C1 and C4 are closest to each other. A comparison of C1 and C5 as well as C2 and C4 shows that in contrast to the previous assumptions there are clear differences in requirements. It can thus be seen that the requirements made on a DMS can only be suggested to a limited extent on the basis of the named parameters.

Conclusion

Even if the previously discussed results of the low number of surveys allow merely a cautious interpretation, the scattering coefficients confirm the observation that the successful sale of standardised DMS software is only possible under extreme difficulty. Customer requirements vary greatly so that improved marketing would appear only to be possible through making individual alignments. However, for reason of fierce competition these must be implemented in as little time and with as few costs as possible. The essential prerequisites for successful marketing of DM systems are a modular software setup, the option to align it to diverging customer requirements plus continuous technological progress.

Regarding the creation of a sound requirements profile the developed concept was positively assessed by all participants. As the participants lacked specialist knowledge about it, the pre-defined requirements catalogue was judged to be very helpful. Those responsible were now able to shortlist the numerous offers available on the basis of the end results. Furthermore, the determined data permit the option of selecting those providers who implement the requirements with the highest priorities best. This can also be done by using AHP.

The successful execution of the pilot project showed that the previously explained concept is suitable for structuring and weighting customer requirements.

Although the AHP was totally unknown as a method of setting priorities it was well received by all the participants - a fact confirmed by the overall low rate of inconsistency - particularly in view of the high number of paired comparisons. Furthermore, this demonstrably shows that the interviewees had no problems in accepting the increased time required. It was noted therefore that increased time and efforts in carrying out the surveys was justified by the increased quality of the requirements weightings.

Converting relative weightings into absolute weightings allows the consolidated requirement priorities to be integrated directly into QFD whereby it is recommended using a method which is practical and at the same time ensures as accurate a conversion as possible seeing that the latter is only limited in the case of linear transformation. A further method was therefore presented which allows conversion on a nine-element scale to provide considerably more precise values and is yet easy to use.

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Prof. Dr.-Ing. Horst-Artur Crostack, born 1945, graduated from the Technical University of Hanover with a Master's degree in mechanical engineering and received a PhD at the Institute for Applied Material Sciences in Bremen. In 1978, he qualified as a university lecturer at the chair for Physical Manufacturing Methods of the University of Dortmund and was appointed to the chair for Quality in 1980. Additionally since 2006, he has been the speaker of the collaborative research centre 696 "Logistics on Demand" and he is also in charge of two of the sub-projects.

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Structuring methods in the run-up of QFD for intralogistic facilities - what seems to be useful for stakeholders?

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Stakeholder, demand, structure, House of Quality, Quality Function Deployment, Stakeholder Analysis

Category:

Research Paper

Abstract:

The purpose of this paper is to present results concerning the applicability of structuring methods. What kind of structure enables a productive transfer into QFD? And going one step further: which stakeholder of an intralogistic facility will find this structuring most helpful? Accuracy in the run-up offers satisfactory results in QFD. And accuracy is often achieved by clarity. Handling intralogistic requirements means dealing with hundreds of data records. Only structuring can achieve a clear overview.

However, a structure can only be useful if the user finds it easy to handle. Therefore, it is also important to consider the different points of view of users. These users are, as a general rule, stakeholders in the facility - stakeholders that have to weight requirements in the run-up or have to deal with requirements as a part of the planning team.

In conclusion, the paper will point out how to structure requirements in order to give all stakeholders an all-embracing overview of the large amount of requirements.

Furthermore working with a large amount of requirements should become more effective and accurate. As a result clustering and weighting of requirement should become easier.

1   Introduction

In order to carry out Quality Function Deployment (QFD) you need to know the requirements of your customers and their priorities. In a project dealing with the design of an intralogistic facility those requirements can be numerous. Intralogistic facilities are internal material-flow systems that serve to bridge goods from the receiving point through manufacturing equipment towards the dispatching area [Jün00]. Intralogistic

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facilities include systems like stock management (e.g. mini-loads, high rack warehouses,…) material handling technology (e.g. belt conveyors, lifts,…) and technology for picking procedures (e.g. sorter). Structuring is essential for planners to handle the large amount of information about those facilities. With the help of structure models requirements can be grouped in order to focus on them during planning stages. The planning stages involve several stakeholders. So the chosen structures should be adjusted to their needs.

The aim of the project A1 "A model for structuring and clustering intralogistic facility demands" in the German collaborative research project 696 [SFB696] is a systematical approach that can be used in the field of product development. This may lead to considerably more customer-oriented products.

2 Useful structures for intralogsistic facilities in the run-up of
Quality Function Deployment (QFD)

The origin of every QFD are the demands of different stakeholders and customers and their emphasis. QFD transfers this basis of information QFD into attributes of the product - in this case an intralogistic facility. Furthermore, interactions of attributes, benchmarking aspects and producibility are examined. Final outcome should be an optimum of product attributes – respectively facility attributes – that fulfil customers' demands.[Akao92]

According to this, a translation of demands into attributes can only be successful if information on demands and their emphasis are conscientiously gathered and handled.

In doing so, handling means structuring of demands. In the case of an intralogistic facility there are big amounts of demands mentioned by different stakeholders. Therefore, it is necessary to give the planning team of an intralogistic facility a comprehensible overview about all information. This can be achieved by a multidimensional structuring model.

In creating a multidimensional structuring model different kinds of structures are used as axis to span a vector space. The categories of each structure are sections of the axis. Thereby a multidimensional vector space is spanned and demands can be mapped as vectors in this space (see pic. 1).

So structures are needed that can classify demands and alleviate their handling. For example: the facility life cycle that divides axis A into the categories planning, realisation, use and close down. Another useful structure is the Kano-method. It divides demands into three categories: basic, performance and excitement requirements. Related to the demand's potential of fulfilling the customer's satisfaction and the fulfilment of the demand by appropriated attributes requirements are separated into those three categories. This is axis B (see pic. 1). With the help of these two axes demands can be displayed as vectors in a 2-dim space. The user of this 2-dim structure model gets to know what kind of demand excite his customer and when this demand will become important in the facility life cycle. (see also [Crostack07a, Crostack07b, Crostack08])
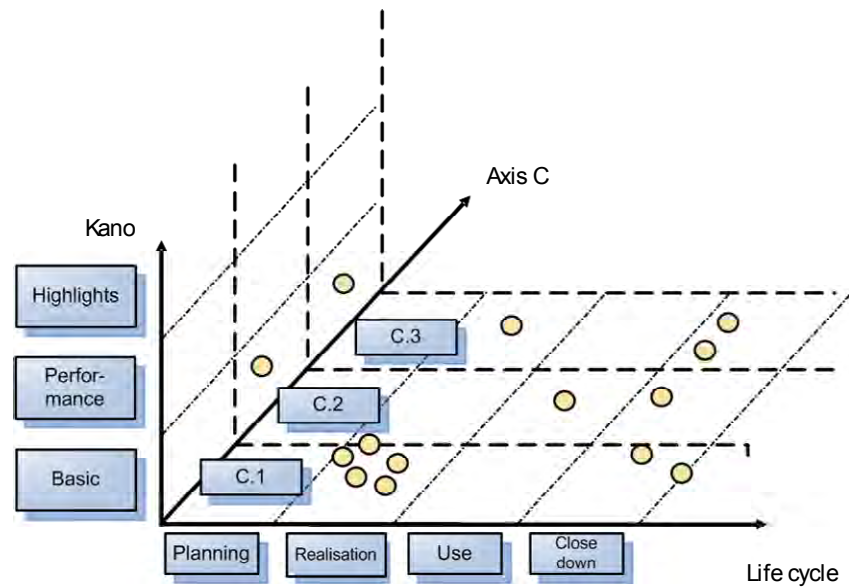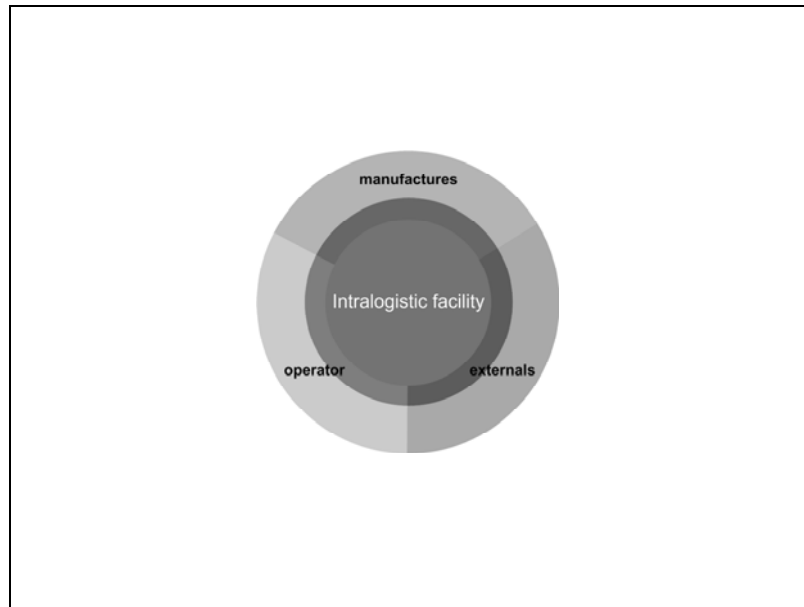
Picture 1: Example of a 3-dim space of a structuring model

But what kind of structure is useful for the different types of stakeholders? To find an answer to this question, stakeholders of an intralogistic facility have to be identified at first.

3 Stakeholders of an intralogistic facility

Stakeholders are groups of customers that have the same interests. Thereby a customer is every person that has demands concerning a product. [Herzwurm97, Janisch92] Examining stakeholders of an intralogistic facility it is recommended to consider three parties – manufacturer, operator and externals – to be able to differentiate their aims (s. pic. 2). For instance, the project managers of the manufacturer and of the operator might have different opinions.

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Picture 2: The three involved parties

Each of these parties includes several stakeholders. Those stakeholders can be classified into two to three groups related to their perspectives. (see pic. 3)
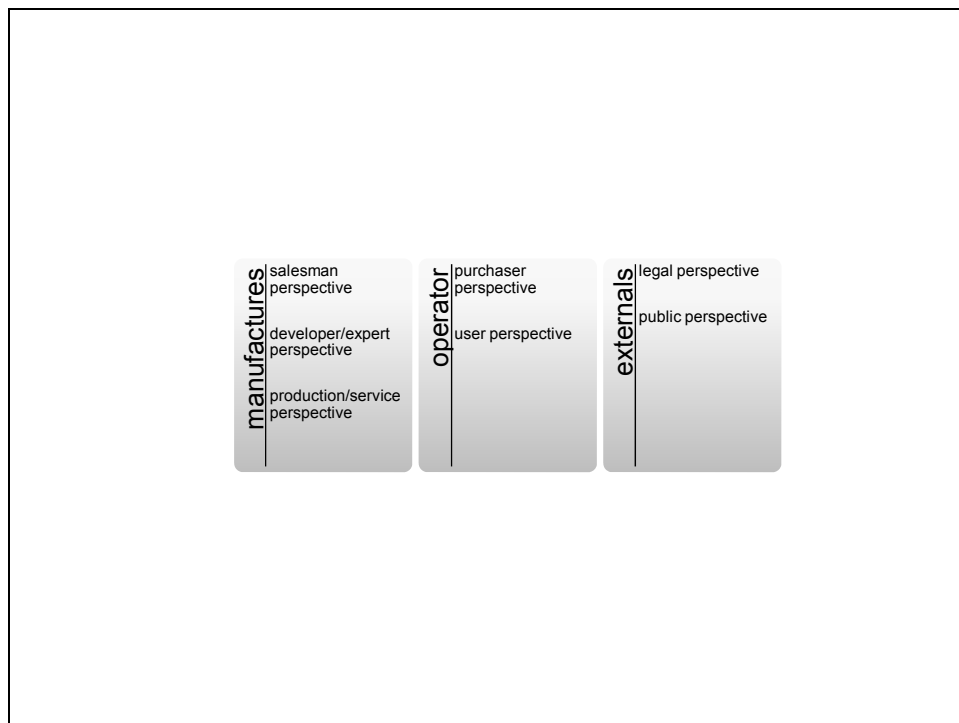
Picture 3: The parties and their perspectives

Within those perspectives different kinds of stakeholders of those parties have to be considered.

Firstly examining the ***salesman perspectiv***e, there are several stakeholders that represent - directly or indirectly - strategic or financial interests of the manufacturer (see pic. 4).

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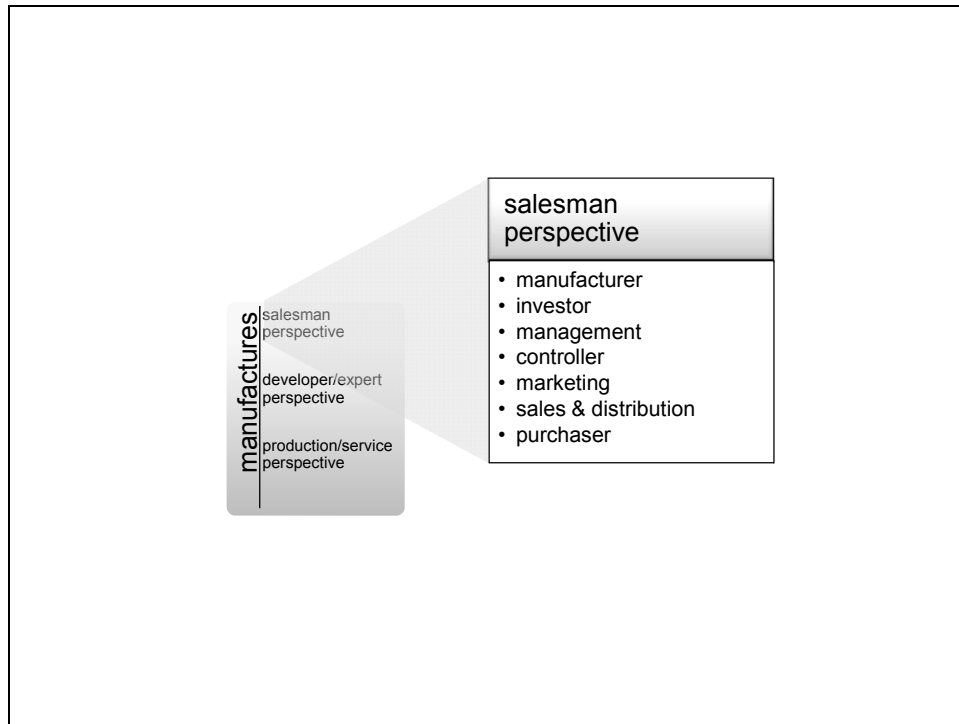
Picture 4: Stakeholders of the salesman-perspective (manufacturer)

The *management* of the manufacturer is interested in the success and survival of its company. It develops strategic company objectives and implements them. The management possesses a strong power of decision and is able to get these interests accepted.

Investors are also interested in the success and survival of their company because they share the companies profits as well as risks.

Controllers support management decisions by editing the monetary business ratio. They include employees of the finance department and have funded knowledge about business economics.

Purchasers of the manufacturer supply the company with resources that are needed for producing an intralogistic facility. They try to achieve this aim by lowering costs, and taking care of reliable delivery and quality.

The *marketing* determines customer needs and requirements in order to include those in the planning of the intralogistic facility. This includes presenting the company and its products in a positive light and keeping in touch with customers.

Keeping in touch is also important for the *distribution* stakeholders. But contrary to the marketing perspective only the interests and wishes of the company buying the facility are considered. Negotiations and contract conclusions are also a task of distribution.

In the following the stakeholders of the ***developer and expert perspective*** are explains (s.

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pic 5). They are involved in the planning and development of a facility. But their demands affect the whole life-cycle of the facility.
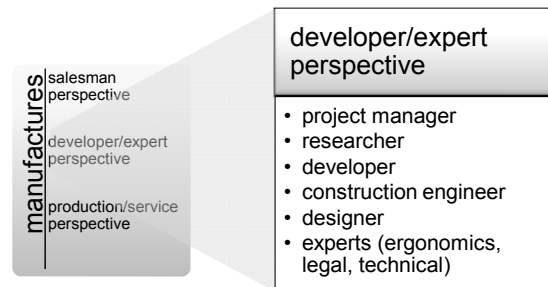
Picture 5: Stakeholder of the developer/expert perspective (manufacturer)

Researchers develop new or optimized technologies to support the development of an intralogistic facility. Their work supports developers.

Developers convert customer wishes into an intralogistic facility. They are supported by other stakeholders who share their perspective. They aim for a facility that satisfies the customer needs. Therefore they use already existing or new technologies. But they also have to find solutions or compromises for problems that result from rival demands.

Construction engineers deal with the design of the facility. They design dimensions, define tolerances and characteristics and are responsible for engineering drawings.

In comparison to construction engineers *designers* focus on the aesthetical appearance of the facility. Their work also includes questions of ergonomic aspects.

Another group is represented by *experts*. This group includes ergonomic-experts that support developers concerning their ergonomic obscurities. Further experts are safety experts, legal experts or IT experts for example. This expert group should be divided into several sub-groups in reference to their different subject areas so that different opinions can be captured.

The project manager coordinates activities and demands of the different stakeholders. His job is to align the different demands.

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Last but not least the ***production & service perspective*** includes production employees, assembler, training and maintenance staff, etc. (s. pic. 6)
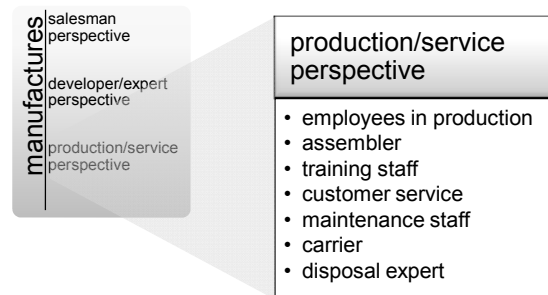
Picture 6: Stakeholders of the production & service perspective

The *employees* of the manufacturer, that produce the facility, are interested in safe workstations. Just as well as the assembler. The latter require also a facility construction that offers easy assembly and also disassembly.

The *training staff* instructs the user of the facility into the handling of the facility. This training can also include contents like maintenance. Moreover this staff works with the facility manual and requires clear instructions.

But it is also possible that the manufacturer offers maintenance as a *service*. Hence the *maintenance staff* can become a stakeholder.

The carrier, engaged by the manufacturer, is responsible for the transport. Often heavy transports are required, so the manufacturer favours the outsourcing of this process.

The waste manager deals with the closing down and disassembling of the facility. This process includes selling of the facility or facility-components, recycling and scrapping.

In the following stakeholders from the operator are determined. Firstly there is the salesman perspective. Stakeholders of this perspective are interested in strategic and financial aspects. They are the counterpart of the manufacturer's purchaser perspective. These perspectives include the same stakeholders. Also their tasks are similar. The only

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difference is the point of view. The one group wants to take advantage for the manufacturer, the other one for the operator. (see pic. 7)
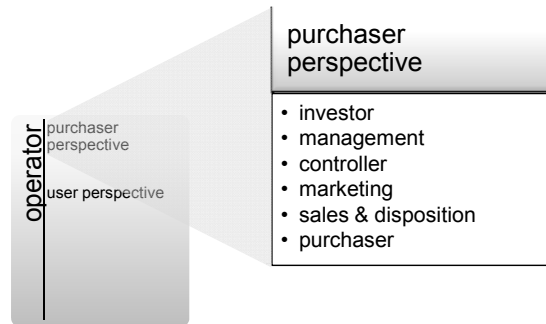
Picture 7: Stakeholder of the purchaser perspective (operator)

The second perspective of the operator is the user perspective. All stakeholders that use the facility are outlined in this perspective. (s. pic. 8)

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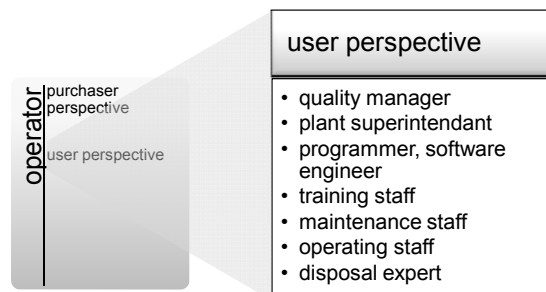
Picture 8: Stakeholders of the user perspective

Again there are parallels between the manufacturer and operator. Some of the stakeholders are also mentioned in the production & service-perspective of the manufacturer. But in this case the stakeholders are not part of the same departments. In this case the stakeholder either exists on the manufacturer-side or the operator side. Here, for example the maintenance staff e.g. can only be part either of the manufacturer side (if the manufacturer offers such services or provides it by a service-company that fulfils the outsourced service) or the operator side if the operator has its own staff for maintenance.

The same applies for assemblers, waste managers and carriers. Laminations should be avoided.

On the other hand there are also other stakeholders who can be allocated to the user perspective with certainty. Those are the facility staff (like pickers, warehouse staff, forklift drivers or cleaning staff) that interacts with the facility.

In addition, there are programmers and IT technicians who deal with data traffic and implement software applications.

The *Quality manager* controls the quality of the logistical output, the status of transported goods and optimizes processes.

The last party - the external party - implies the legal (s. pic. 9) and the public perspective.
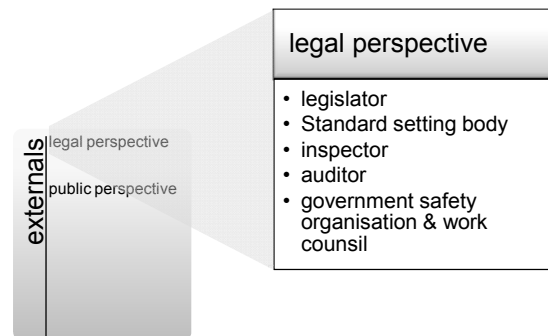
Picture 9: Stakeholder of the legal perspective (externals)

The **legal perspective** includes the legislator that implements laws, controls compliance

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and sanctions defiance.

Standard setting bodies publish engineering standards that have to be considered during the whole life cycle of the facility.

Inspectors like the Technical Supervisory Association or the fire department also check the compliance of formalities.

The *workers' council of producers and operators* as well as *employment protection and collectives* are concerned with interests of the staff. Among other things they demand safe and health conscious working environment in production and utilisation of the facility. Since the workers' council is a legal body for the representation of workers' interests and as such does not have the perspective of the producer or the operator, but represents legal rights of the employees it belongs to the legal perspective and not to the producer or operator perspective.

It is important to examine the **perspective of the public** as the second external perspective to determine which stakeholder group they belong to. (see pic. 10)
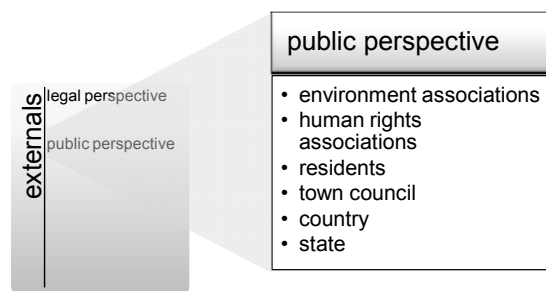
Picture 10: Stakeholders of the public perspective (externals)

Human rights groups are fighting degrading working conditions and childrens' labour, which are especially common in foreign low wage countries.

Environmental groups concern themselves with the interest of the environment and environmental protection. They are especially active in the areas of emissions and facility extensions.

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Also *residents and citizens*, which are effected by the emissions and the facility extension, are fore mostly concerned with their own health and the beauty of their neighbourhood, besides the impacts on the environment.

Communes as well as *regional and national governments* have the same requests as the residents and the environmental groups. However, they are also interested in taxation, subsidies and benefits as well as the number of jobs that are being created in connection with the logistical facility.

Further stakeholders, which belong to all the seven perspectives are the *project opponents.* These are stakeholder with a power potential, which are against the realisation of the facility project. In this way the purchasing of a logistical facility can lead job reductions or the reorganisation of the business, which can result in changes to existing working processes of each stakeholder. Also investors can have a negative attitude to the purchase of a logistical facility as investments can be very high.

Thus every stakeholder of a logistical facility can be a potential project opponent and in any case should be involved in the planning process as early as possible to prevent resistance. If this is not done the resistance of an opponent with a very high power potential can lead to the failure of the whole project.

In conclusion the following list of stakeholders can be presented:
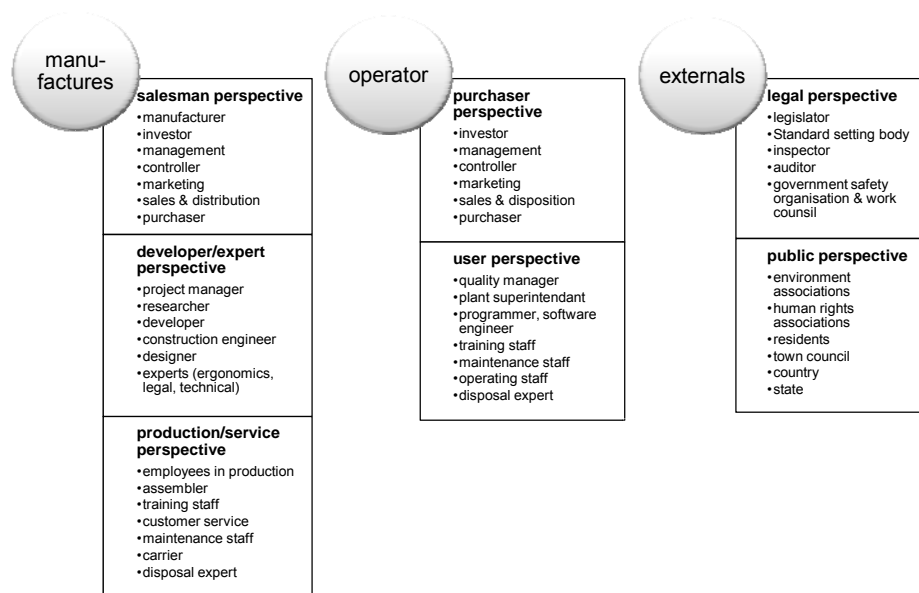
Picture 11: Stakeholders of an intrlogistic facility

Please note that the above list represents the current research status and makes no claim to be complete. However, it offers a first attempt to take the complete set of stakeholders into account.

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4   Useful structures for stakeholders

In order to identify what structure is useful the stakeholders´ main tasks have to be gathered. Based on the main tasks the respective demands of the stakeholders and their subject areas of interest can be derived. These perceptions can be found in table I below "structure needs of stakeholders".

4.1   *Main tasks of manufacturer-stakeholders and their needs*

Based on the given description of the facility stakeholders above the main tasks of the manufacturer stakeholders are identified as an example. Thereby, keywords are declined that are related to the stakeholder´s tasks. The stakeholder needs for structures are then derived from the information about their main tasks. Those requirements indicate what information has to be provided in what kind of structure to support the stakeholder´s work and decision making process.

Table I: Main tasks of manufacturer stakeholders and their structure needs

Stakeholder		Main tasks of stakeholder	Structure needs of stakeholders
Manufacturer	*Salesman perspective*		
	Investor	Checking of investments, risk assessment	Cost, time-frames, risks, potential
	Management	Strategic business decisions	Cost, time-frames, contract aspects, capacities, efficiency, marketing
	Controller	Cost minimization, monitoring, generation of figures	Costs, benefits
	Marketing	Growth in customer base, costumer loyalty	Performances, customer satisfaction, external demands and wishes,
	Distribution	Sale processes, bid proposal management	Customer satisfaction, time-frames, contract aspects
	Purchaser	Provision of resources	Time-frames, resources, costs, components, material

	Developer/Expert-perspective		
	Project manager	Coordination of developers and expert, processes, monitoring, controlling, mile stones	Costs, time-frames, demands of experts and developers, resources
	Researcher	Detection and dealing with potential fields of research	Engineer standards, law, technical and functional demands
	Developer	Implementation of innovations, problem solutions, fulfilment of functions	Technical and functional demands, expert opinions,
	Construction Engineer	Realization of planning, fulfilling functions	Engineering standards, laws, ergonomics, kinematics, dimensions,…
	Designer	Layout, aesthetics, ergonomics	Customer satisfaction, ergonomics, aesthetics, corporate design
	IT-Expert	IT-implementation; alignment of different systems	IT-demands, periphery, data base, control systems, material flow systems, material flow computers
	Expert for ergonomics	Elimination of risks for humans	Ergonomics, engineering standards, laws
	Safety expert	Warranty of safety	engineering standards, laws, fire prevention
	Legal expert	Compliance with laws, contractual hedging	engineering standards, laws, contract aspects
	technical expert	Solutions for specific technical problems	Kinematics, dimensions, functional and technical demands…
	Quality expert	Quality warranty, documentation, robust processes, inspections,…	engineering standards, laws, processes, inspections, measurement equipment
	Productions/Service-perspective		

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	Training staff	Organization and performing trainings	Process information, technical components, system data, handbook,…
	Customer service	Performing services	Customer satisfaction, system data, maintenance, service
	Maintenance staff	Attendance, inspection, reparation, improvement	Customer satisfaction, system data, service, technical and functional demands
	Carrier	carriage	Time-frames, costs, transported material
	Waste manager/ Environment manager	Organization and performing of recycling, disposal,…	Materials, endangerments, time-frames, costs, recycling aspects, engineering standards, laws, organization

In the following the stakeholder's designer and maintenances staff of manufacturers exemplify the main tasks of a stakeholder and their consequences for structure needs.

4.2 Stakeholder Designer

Designers deal with the aesthetic concept of an intralogistic facility. This includes the selection of colours that are related to the corporate identity, aesthetic design of forms and consideration of ergonomic aspects.

This means, that designer need information about ergonomic demands and customer design demands. Thereby customer design demands include not only assumed demands like corporate-identity colours but also customer unexpected demands whose fulfilment leads to customer satisfaction.
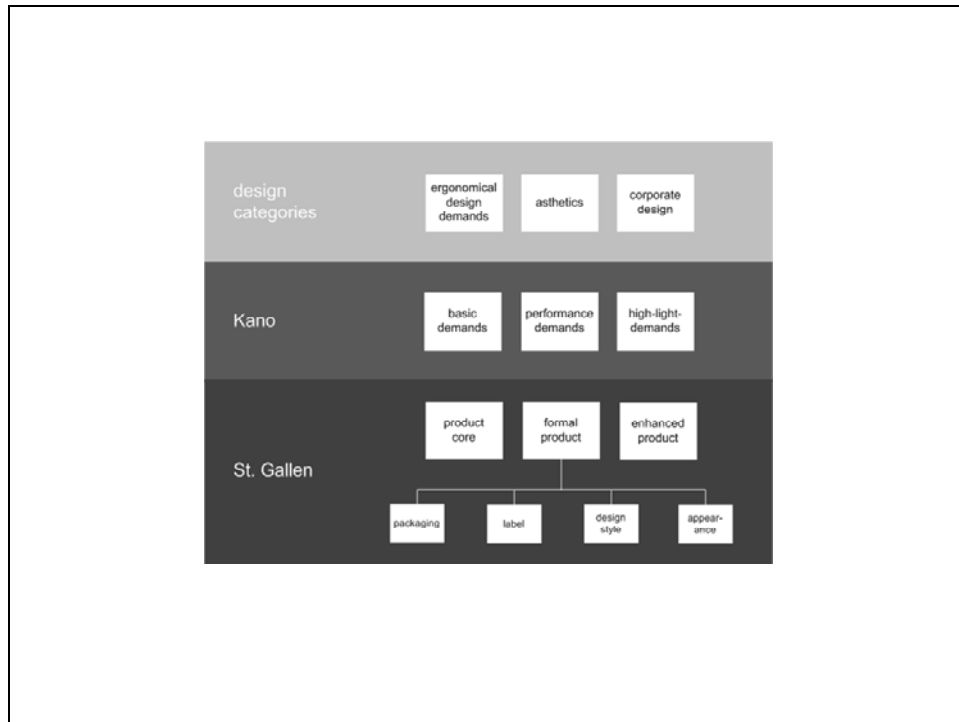
Picture 12: Structures and categories for designer (manufacturer)

Accordingly designer-orientated structures have to classify ergonomic demands. Furthermore a classification of aesthetic demands is useful to facilitate the designer's focus on his main task. Another potential structure is the product model of St. Gallen that divides demands of the formal product into the classes „packaging", „labelling", „design/styling" and „appearance". [StGallen]

Moreover the classification of demands by Kano is of great importance. The classification in „basics", „performance" and „highlights" [ASI89, Cohen95] enables the designer to pick specific customer satisfying demands concerning and integrate them into the design of the intralogistic facility.

4.3   Stakeholder Maintenance staff

On the one hand the maintenance staff of the manufacturer deal with maintenance demands of the facility operator. On the other hand they bring in their own demands for a maintenance-orientated facility, so that an effective maintenance is possible during the operation of the facility.

The maintenance is a sub-process of the facility life cycle „use". So it seems to be useful to apply a structure concerning the process respectively to the sub-processes. In this context it can be reverted to the engineer standard DIN 31051 that divides the maintenance process into the sub-processes „inspection", „repairs", „attendance" and „improvement".[DIN 31051] In the first instance functional demands can be classified into these groups.

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By more detailed sub-classifications it is possible to structure all kinds of abstract-level demands. This enables the maintenance staff to focus on a specific problem of a system or a component.
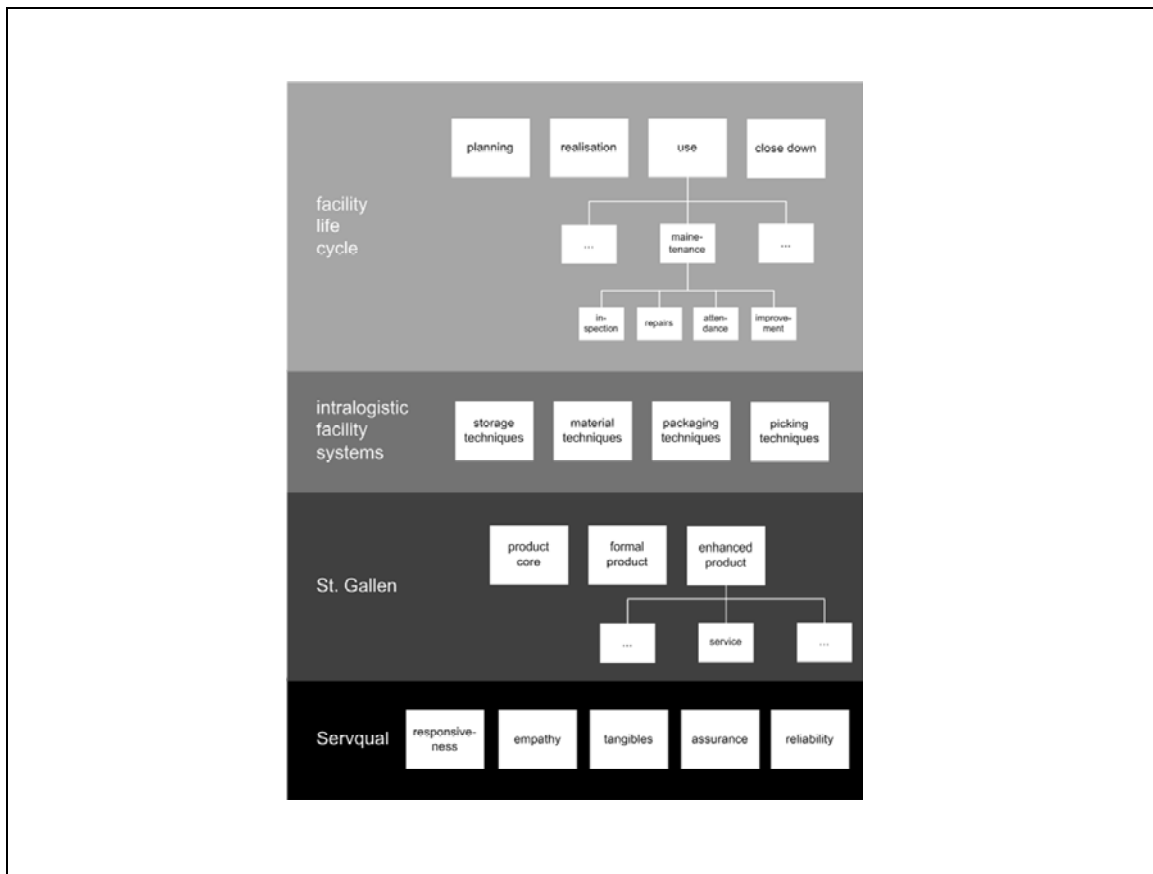
Picture 13: Structures for maintenance staff (manufacturer)

Alongside manufacturer demands of maintenance that have to be realized there are also customer demands related to the maintenance service that have to be considered by creating useful structures. At first structuring according to the product model of St. Gallen is advisable. Here demands of the service are objectively enlisted within the class „extended product". Furthermore the use of Servqual as another structure is an important component for a customer-oriented maintenance. Servqual offers the possibility to measure maintenance-services by subjective customer values. [Hoeth02, Zeithaml92] With the help of a Servqual-structure the maintenance staff can analyze their service and improve future services and facility planning.

4.4 Stakeholder orientated structures

The given examples above already show that structures like Servqual [Zeithaml92], St. Gallen [St.Gallen], DIN 31051 [DIN31051] etc. can optimize the handling of maintenance demands.

For designers the Kano model is very important. Furthermore classes respectively structures like St. Gallen are needed.

With the help of other structures also other stakeholders should achieve use-oriented structures for an easy handling of demands. Potential structures for construction engineers are structures that break down functions and components. But also another structure based on the Servqual-systematic that displays the customers´ opinion about component or product elements is preferable.

On the other side managers and controllers have different perspectives. At the moment the redevelopment of structures according to Firchau, Krusche, Ehrlenspiel, etc. [Firc90, Krus00, Ehrlen03] should classify financial and resource-aspects for an efficient handling. A more detailed sub-classification is aspired as well so that the different abstraction levels can be considered. The same is applied to the classes „information", „ergonomics" and „demands from documents", while the last mentioned class can be sub-divided according to origins like „engineering standards", „law", „guarantee" and „patent". With the help of this structure a displaying of external stakeholder relevant demands and an examination by the planning-teams is possible.

5   Conclusion

Considering the stakeholders´ needs for structures the described n-dimensional structure model should become more effective, because the handling of information becomes easier for stakeholders. Furthermore gaps in demand knowledge should be identified. So specified demand gatherings can close those knowledge gaps. The gathering of information, supported by this structure-model, should become more and more efficient.

The first results of a stakeholder oriented structure was presented in this paper and further research potential, e.g. a new structure for product quality based on Servqual, was identified.

Moreover stakeholder oriented structures should be examined concerning their possible integration into the n-dimensional structure model.

In the medium term practical tests will be performed. It is expected that practical tests require a more detailed sub-classification of already existing structures but also more structure aspects that lead to an enhancement of given structures.

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Components of a requirement of an intralogistics facility

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Abstract:

Originality / value

In this paper, we present the steps taken to develop the prototype of an IT-based requirements management system for the domain of intralogistics facilities. So far, there is no RM system which takes into account the specific constraints of the intralogistics domain and which uses domain ontologies to facilitate the machine-understanding of stakeholder demands.

Purpose

When planning and designing large production or conveyor facilities according to customer needs, a large number of stakeholders along the product life-cycle and an accordingly large amount of demands have to be considered. Thus, computer-based methods have to be developed which "understand" all requirements and prepare them for further processing.

Methodology

Comparable approaches from requirements engineering and software engineering and their respective limitations were used to form a baseline model in which core components (e.g. "source" and "intended feature") were identified. Next, example requirements were taken from interviews, literature or sales catalogues. A comparison of those requirements led to a requirements data model. It represents the information possibly contained in a stakeholder's demands. This data model was implemented in a relational database, and a framework to create and use domain ontologies to integrate domain knowledge and logistics-specific wording was developed.

Findings

The data model is sound with respect to all requirements studied so far. The attributes collected during the original template creation serve as the foundation for an intralogistics ontology. The application collects additional attributes which can later be used to extend the domain ontology. This enables a designer of intralogistics systems to use additional structuring techniques and thus facilitates the planning of such a system.

Keywords

requirements management, intralogistics, data model, domain ontology, transport components

Paper type

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Research paper
Introduction

The long-term objective of this project in the context of the German Collaborative Research Centre 696 (hence the prevalence of German references) is the development o a semi-automatic planning system which uses techniques such as Quality Function Deployment to infer the best design and layout parameters of an intralogistics system from a given set of stakeholder requirements.

The term *intralogistics* in general refers to in-house conveyor systems used to transport goods between specified locations (ten Hompel, 2007). Common examples of intralogistics systems include belt conveyors in airport buildings, used to transport luggage and other transit goods, or conveyors and sorting facilities used by postal services. The *intralogistics facility* comprises all the technical, economical and socio-economical aspects of those material flow systems. From a technical point of view not only the conveyor system along with its technical components (up to the control software used to organise the material flow) has to be considered, but also the context in which it will be used.

In most cases, intralogistics systems are used as a means of transport within the production process of a company, i.e. the *customer* obtains an intralogistics facility in order to produce goods using this facility. Only few organisations (e.g. waste disposal or postal services) employ those systems as a direct means of doing business. Therefore, we focus our work on requirements management and analysis for business-to-business relations between companies and the stakeholders involved.

Our approach is a comprehensive analysis of all stakeholder demands. Those demands, often referred to as requirements, shall eventually be transformed into a real product using techniques such as Quality Function Deployment (Akao, 1992). The requirements management system will have to support not only the customer, i.e. the company ordering and purchasing the facility, but support all stakeholders concerned with it. This way, each and every demand which arises along the product life cycle can be made available when first planning the entire intralogistics system. However, the product life cycle is not a fixed sequence of processes, but may vary according to the point of view of the stakeholder. Nevertheless, a common and simplified product life cycle model identifies the following stages: planning, design, assembly, use, maintenance and disposal. Each stage may also be subdivided into smaller tasks. Such a model helps to identify every stakeholder involved, thereby revealing possible human or organisational according to the stakeholders involved.

Including all the relevant demands of every stakeholder along the product life cycle is one of the main problems facing the producers of intralogistics facilities today (Crostack, 2006). Up to now they concentrate solely on performance and robustness issues, mostly unaware of the implications of their design for maintenance tasks and the overall flexibility of the facility. Most of those problems arise from the use of out-of-the-box design of conveyor systems. The available standard components each producer has in its repertoire are used to assemble and build the "required" facility (ibid.). At this stage, the planning is driven primarily by the experience of the designer, not by the actual requirements of the stakeholders who will have to work with the system in the future. This lack of individual design, of "customising" and shaping of the systems to the demands at hand leads to a lot of in intralogistics facilities being "oversized". This, in turn, results in both much higher acquisition and operating cost than would otherwise be necessary. Using our requirements management system we want to customise facilities according to the original stakeholder requirements.

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Aim and related work

When planning and designing large production or conveyor facilities according to customer needs, a thorough understanding of each stakeholder's requirements is essential for the planning system to translate those demands into the system they describe. However, a large and often inhomogeneous group of stakeholders express their wishes and requirements concerning the planned facility. Due to the large number of stakeholders along the product life-cycle, an accordingly large amount of requirements has to be processed during facility planning. Therefore, computer-based methods have to be developed in order to

- store and retrieve requirements according to search criteria
- cope with the amount of requirements and product specifications
- process (compare, weigh, change,…) requirements and subsequently design the desired facility.

The last part necessitates that the underlying IT system "understands" the desired property expressed in the stakeholder's requirements. At this stage, we assume that each requirement contains or otherwise expresses at least one property of the intralogistics facility to be built. The exact definition what this "property of a system" might be, will be determined in the course of this work.

The logic behind our requirements management system consists of several building blocks. Foremost, there has to be a definition of the term *requirements* which must encompass all the relevant pieces of information needed to describe its purpose (i.e. the target property of the final system intended by the stakeholder). We can then use this definition to deduce information categories characterising such a requirement. Those information categories then lead to an abstract data model for stakeholder requirements. In addition, this data model is then used as a foundation for a relational database model, on top of which the prototype of a web client-based requirements management application is build. This way, the application serves two purposes: on the one hand, it helps validating the data model, identifying requirements whose information cannot be mapped to the data model, and on the other hand, it may be used to identify common terms and wording in the field of intralogistics requirements.
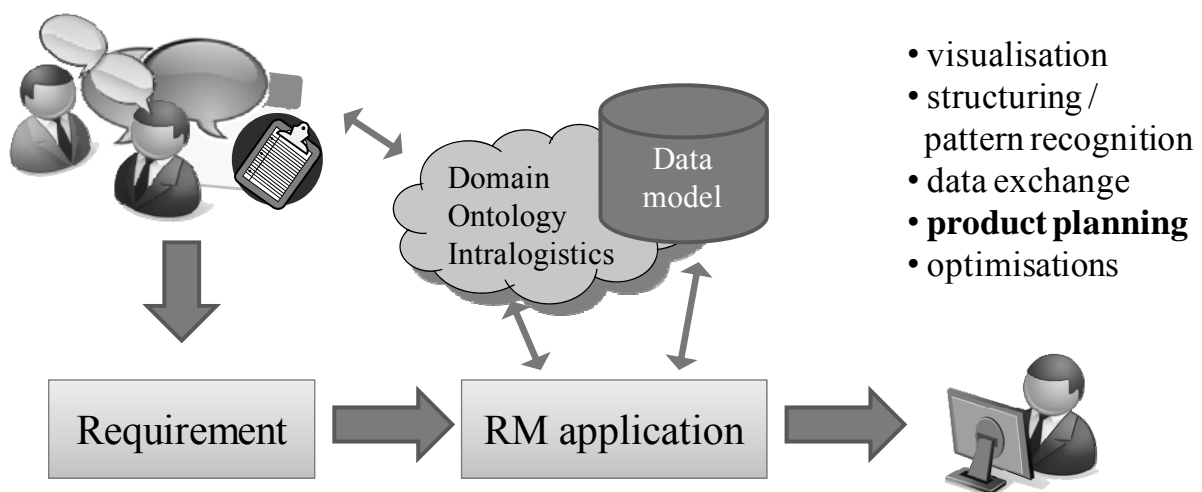

Figure 1: Aim and constituent components of our requirements management system

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The latter part is of particular importance, since we try to support the requirements of all stakeholders involved with an intralogistics facility and their corresponding "voice of the customer" (Griffin, 2003). Even the coarse distinction into planning, design, assembly, use, maintenance and disposal stages shows the varying technical background of the stakeholders considered. We refer to this background as the *domain* of a stakeholder. Therefore, there are several (distinct or overlapping) sub domains within the domain of intralogistics systems, each which their own technical terms. Analysing requirements expressed by different stakeholders, we have to consider variations in the meaning, in the semantics of the terms used. In order to capture those distinctions and similarities, we create and use a domain ontology for the field of intralogistics. The concept of ontologies is taken from knowledge management methodologies, where they represent real-world objects, concepts and terms and the conceivable relations among those entities.

There are several comparable approaches to requirements management in literature. Excluding psychology-centred methods towards requirements elicitation ("marketing", customer feedback and interview techniques), we distinguished two main schools of requirements management. The first one stems from traditional design concepts in mechanical engineering, while the second one, requirements engineering, concerns itself with requirements arising in software development.

In mechanical engineering (Pahl, 2006) concentrates on the implications of customer requirements on the design of a product. He presents a list of properties common to most products, like geometry, flexibility, functionality, etc. This list should be used to help capture all necessary requirements as well as identify missing requirements. This approach, however, is too broad to be used in our system. (Kläger, 1993) proposes a requirements model for design problems (for a CAD environment) as a part of a conceptual product model. (Kickermann,1995) and later (Heimannsfeld, 2001) describe a general requirements management process which concentrates on the formalisation of requirements via textual analysis and the formalisation of a system model. All three concepts, along with (Krusche , 2000), concentrate on structuring functional requirements and try to devise methods to infer a feasible solution for a construction problem. In (Humpert, 1998), a requirements model is developed in order to identify relations between requirements. Each approach lacks the support of a product life cycle model for the desired system and thus lacks support for the demands and varying domains of stakeholders in the context of an intralogistics facility. (Rzehorz, 1998) and (Müller, 2007) employ knowledge management techniques (e.g. software agents) to map requirements to possible solutions, including constraints on their practicability, but both assume requirements can be sufficiently formalised and "understood" by a computer.

In the field of software development, we considered the works of (Rupp, 2005), (Ebert, 2005) and (Schienmann, 2002), along with result from (KARE, 1998). Due to the immaterial nature of software, software requirements and requirements management have a strong focus on traceability, testing and project management issues where the tasks ensuing from each requirement have to be controlled. Again, each approach presents a data model for customer requirements, but they mainly rely on manual detection of dependencies and manual assignment of solutions. Models and reference processes have to be ported to the domain of intralogistics. Additionally, the stakeholders' different domains and their correspondingly different languages have to be taken into account.

The data model and its information categories

Hence, in short, our research objective was to establish a unified model for requirements in the context of intralogistics facilities. The requirement model should incorporate the specific

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domains of all groups or representatives involved, since the quality of the planning process directly depends on the ability of the planning system to represent and understand requirements and to handle them in an efficient and mostly automated way.

In the following, we describe the development of a data model and its use in a requirements management application. When appropriate, the use of our domain ontology is sketched. Since its development is still an ongoing task, it will only be presented as part of an example.

At first, we checked the aforementioned approaches from requirements engineering and software engineering for a suitable definition of "requirement". Since the domain of intralogistics so far lacks common requirements management techniques, we devised a first requirements definition as a starting point:

"Using a requirement, a stakeholder describes a future property of an object, a process, an action or a person".

This definition helped identify three basic components of our requirements system:

1. *Stakeholder*: as already mentioned, our approach tries to encompass each stakeholder concerned with the intralogistics facility. Unfortunately, there is no comprehensive and generally accepted list of stakeholders in intralogitics. As a workaround, we propose to use a product life cycle model to identify stakeholders and map them to certain stages in return.
2. *Target*: each requirement is targeted towards some part of the intralogistics facility. This part may either be a technical component (like a belt or a drive in the context of belt conveyors), or an "organisational component" of the system, like a requirement describing some future process.
3. *Property*: the "target" of a requirement is only one part of the actual demand. Apart from the component itself, we also need to know which feature of this component is expected by the stakeholder. This way, every target component offers a set of properties which represent either static aspects (attributes) or dynamic aspects (behaviour) of that component.

Next, we broadened our analysis and tried to compile a data model which can be used to structure the information contained in a stakeholder requirement. This data model also should represent a requirement with the least possible loss of information. Therefore, we reviewed existing data models (see above) and their respective limitations. As a guideline, we extracted quality criteria form (Rupp, 2005) and (Humpert, 1998), like clarity, "disambiguity", verifiability, traceability and foremost "independence from implementation".

The comparison of existing approaches yielded some valuable ideas for a baseline model in which core components of a stakeholder's demand were identified. Next, customer-specific as well as customer-unrelated requirements were gathered as prototypes for requirements. They were taken from interviews conducted with stakeholder representatives, from literature or sales catalogues. We then compared those requirements for similarities and differences, identifying common information categories which we assembled in our requirement model. In order to structure the information contained in this template we grouped similar information categories.

We then subdivided all information categories into primary, secondary and tertiary data. Primary data comprises all information directly accessible when gathering requirements during requirements elicitation. Secondary data represents further knowledge which we can gain by considering several requirements at once, like interdependencies or constraints. Tertiary data result from combining requirements and dependencies with additional

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knowledge about the intralogistics system, e.g. a chain of technical implications. The latter type of data has been included to facilitate future work such as translation of requirements into product features, but it will not be considered in the following.

Each information category describes an aspect of a stakeholder requirement. For each such category, a set of attributes has been gathered, representing the possible range of values for the category. Figure 1 depicts the relevant categories and the corresponding headings. We defined those headings to be "source", "priority", "reference", "situation" and "constraints". Apart from those, the storage of central master data has been proposed to simplify retrieval of the requirements, like requirements text, date and time of elicitation, project reference etc.

Source	Priority	Reference	Constraints	Situation
Stakeholder	Priority acc. to Stakeholder	Reference object	Type of Relation	State
Method of Elicitation	Importance for Project	Property	Related Requirement	Time of Implementation
Type of Derivation	Importance of Stakeholder		Circumstances	

Figure 2: Information categories grouped together under five topical headings

The "source" of a requirement consists of:

- *Stakeholder*: this category represents the stakeholder who expresses a requirement. However, a requirement can originate from a lot of different types of sources. Thus, a stakeholder might be
    - a real life person with whom an interview has been conducted
    - a role name for a group of people who share a common goal
    - an abstract source such as a job norm (or law, standard, etc.) dictating certain properties of our facility

    Furthermore, when combining group names, role names and individual stakeholders, we get not just a list of stakeholders but an extensive stakeholder hierarchy, which can be represented as a tree or as a graph of stakeholders. This way, we can keep track of the original stakeholder and his relations to other stakeholders who may have contradictory requirements.

- *Method of elicitation*: this category states which kind of techniques have been used to gather the requirement. Possible methods range from simple "text-based" research (in the case of job norms or existing requirements specification documents) to sophisticated interview techniques applied when talking to a group of domain experts.

- *Type of derivation*: this category expresses the type of interpretation a requirement has undergone prior to its being entered into our requirements management system. A requirement taken from job norms or other standards can be analysed "as is", while statements taken from interviews may be interpreted, resulting in a possible shift in their intended meaning.

Our approach which tries to consider every stakeholder of the intralogistics facility has to include interview techniques as well, because it may help bridging the gap between what is expressed as a requirement and what is actually wanted.

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The "reference" category of our data model is our main interface to the domain ontology for intralogistics. We distinguished a reference object and its property, both information categories depending on each other. They are used to describe the intention of the requirement, i.e. its target and the feature it should provide. Therefore, possible reference objects and their possible properties in the context of an intralogistics facility have to be stored in a "system model". This model also must include abstract concepts like flexibility as well as technical features of an intralogistics facility ("the speed of conveyor xyz").

Due to the large amount of stakeholders, the representation of abstract concepts is a difficult task. Depending on the stakeholder, the meaning of "flexibility" may vary enormously. A facility manager may take "flexibility" to mean "extensible for future products" whereas a worker with the facility may see flexibility as "varying degrees of speed". Those distinctions in meaning have to be captured in our domain ontology, rendering the data model independent of actual terms and notions.

A requirements management system for different stakeholders will have to cope with certain relations between requirements, such as requirements contradicting each other or their being supplementary to one another. In order to prioritise those requirements, three different methods have been included. Firstly, the importance of a requirement can be determined from the point of view of the stakeholder expressing it. For example, a requirement derived from law texts is of great importance in the realisation of the facility. Otherwise, the stakeholder himself must provide an estimate of the importance of his demands. Secondly, the importance of the stakeholder himself has to be assessed. Thirdly, the importance of a requirement in the overall planning process must be determined. It may vary significantly from the priority a stakeholder has awarded to his demand.

The "constraints" category is used to formalise dependencies between requirements. The *type of relation* offers the possibility to characterise those dependencies. A "refinement" for instance signals that a requirement A is more detailed than requirement B where both A and B have the same target component. The *circumstance* offers additional explanation why the dependency holds. Both notions are subject of current research.

Once processing of the requirements has started, the "situation" category keeps track of the *state* of those requirements. The *time of implementation* defines the point in time when a requirement first has to be implemented in the facility.

Use of our data model

These findings with respect to the necessary information categories make up our first prototype for the requirement data model. Due to the broadness of our approach, the possible attributes of each category have not been analysed "in depth". So far we have only got a general idea which attributes might be applicable in the context of certain categories. For instance, the stakeholder hierarchy is still incomplete, but a general model of different perspectives can be applied.

However, the implementation of our data model in an application prototype helped significantly in the gathering of further attributes which will now be provided to the user. This way, we were able to extend the possible "range of values" for each category.

The data model was transferred into a relational data model using entity-relationship-modelling. Based on this implementation, a web application prototype was developed (Crostack, 2007). The application itself is browser-based, being written in PHP and run in an Apache+MySQL environment (URL 01) (URL 02) (URL 03). As discussed above, we have

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identified the information categories necessary to describe and structure the information contained in a stakeholder requirement. The content of each category is analysed during further research. Comprehensive coverage of every possible attribute is infeasible, since we aim to support a large group of stakeholders. Common terms used by each stakeholder have to be included in our domain ontology in which each technical term can be equipped with contextual semantics so that we can give the "correct" meaning to every known target object and every property. Terms and word so far unknown to the system pose an additional problem to the domain ontology, since it has to be extensible and it has to be developed incrementally. Therefore, we devised an approach to cope with additional attributes for the existing information categories.

At first, we had to consider the internal structure of our attributes. It became clear, that the denomination "range of values" may just be seen as an analogy. It is misleading in several ways:

1. As previously stated, the range of values, i.e. the set of possible attributes for an information category, may not be complete. Since we follow a knowledge-based approach towards requirements formalisation, and knowledge is always extensible, so are our attributes.
2. Attributes for some fixed category may not be of equal value or of equal rank. As we have seen in the case of the "stakeholder" category, attributes like stakeholder roles may well be subdivided into more specific ones. The "manufacturer perspective" can contain several role names such as "buying agent", "designer" or "assembler" which in turn can be divided into role names of their own (see figure 3). This results in the attributes being arranged in a tree or a directed graph.
   On the other hand, the attributes for the requirement's entry date are nothing but a list of all possible dates, none of with is more important than the other.
3. There are dependencies between certain attributes. This became most obvious with the "reference object" and "property" categories. The attributes of the first one comprise all technical and organisational aspects of the intralogistics facility. The attributes of the property category have to reflect all features of the reference object.
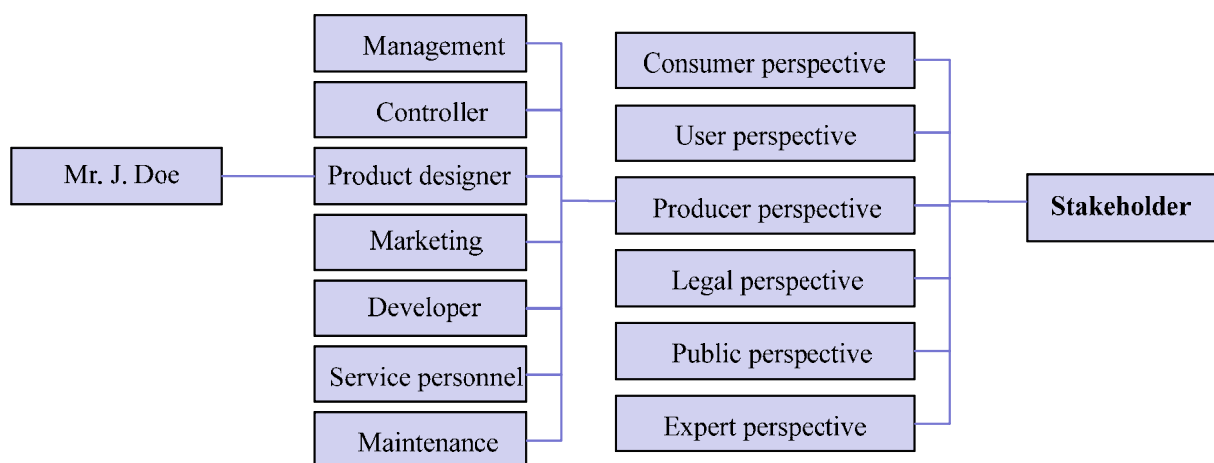
Figure 3: The stakeholder hierarchy presented as a tree.

To help gather attributes for our information categories we offer three different kind of input mechanisms in out requirement management application.

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1. We provide the user with a preselected and pre-structured list (or graph) of possible attributes, one of which the user can choose to characterise the requirement at hand.
2. The user is offered a text field for free text input. If no pre-structured attribute seems fit, the user can enter a term of his own.
3. Terms and items previously entered for this category by this or other users are also made available in the application. Unfortunately, due to the nature of our information gathering, terms entered this way cannot be structured by the user.

The identification of relevant information categories and attributes and their transformation into data objects allows for the use of additional structuring techniques. For instance, clustering methods can be applied to find patterns and related requirements. Those results can then, in turn, reduce the number of requirements needed to consider when designing the desired facility.

Conclusion and future work

So far, we have assembled a list of about two hundred example requirements. They were taken from literature on intralogistics and material flow systems, derived from products found in sales catalogues and from interviews with colleagues working in special subdomains of intralogistics, e.g. drive optimisation. We entered those requirements into our data model and evaluated its ease of use and the completeness of the chosen information categories. Table I shows the results.

Category	Result
Stakeholder	necessary, but no complete list of stakeholders available yet
Method of elicitation	pre-structured list of methods taken from literature
Type of derivation	"taken directly from text", "interpreted from text", "interpreted from interview"
Priority acc. to stakeholder	important, but very difficult to obtain
Importance of stakeholder	can only be estimated
Importance for whole project	Important, but unable to obtain any results, since the scope of the project cannot be defined
Reference object	"Target" of a requirement. Has to be extensible set of terms
Property	Relates to reference objects. Defines features of the desired facility
Type of relation	"part-of", "includes", "leads-to", "contradicts"
Referenced requirement	The end point of the relation
Circumstance	additional description
State	List of possible states: "open", "in review", "accepted", "implemented".
Time of implementation	Can be split into specific dates and temporal dependencies between requirements

Table I: Analysis of categories

Our analyses show that we have identified the most important pieces of information necessary to document stakeholder requirements without loss of information, and due to the use of a domain ontology without considerable loss of meaning. However, there are several information categories which we could not fill in without much extra work. Every category with regard to the importance of a requirement poses a problem, since the required information is not available. Up to now, stakeholder requirements have not been gathered in a structured and standardised process. Thus, there is not method available to assess the

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importance of a certain requirement for the success of the implementation of an intralogistics facility. Therefore, a simplification of our model would be to merge the three priority-related categories into one, for the time being, until more precise result can be obtained. Towards this goal, methods of rating and ranking, as well as sophisticated techniques like AHP (Saaty, 1990) might be employed.

Although this approach may be used in different applications, all research conducted so far concentrates solely on the intralogistics domain. Due to the large amount of time needed to create useful domain ontologies, no comprehensive analysis of large requirement set has taken place yet.
Our findings will help enforce the use of requirements-based planning and design methods especially in the business-to-business sector. Stakeholder demands can be documented in a straightforward way using both a data model and domain ontologies. By giving meaning to known terms and relating them to one another, automatic reasoning about requirement dependencies and their later transformation into a product is made possible.

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MANAGEMENT SYSTEMS:
INTEGRATION DEGREES. EMPIRICAL STUDY

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Abstract

Purpose: The aim of this research is to study the degrees of integration of different Management systems (MS) within organizations.

Methodology: A questionnaire was mailed to 362 Spanish organizations asking about the level of integration of resources, documentation and procedures. All companies of the sample have, at least, ISO 9001:2000 and ISO 14001:2004 implemented. Multivariate statistical analysis was used to test the hypothesis: first reduction of data and then a cluster analysis in order to classify the organizations of the sample into few groups representing the levels of integration.

Findings: Companies are classified into three groups, each of them integrating at different levels: harmonization, cooperation and amalgamation. In harmonization (8 organizations) the level of integration is partial and cooperation (41 companies) is the next step, that is, more than partial integration but not full integration yet. Finally, the last group of companies (310 organizations) has full integration of their management systems. A great number of companies integrate their MS but there is a lack in understanding the concept of integration.

Research limitation: The sample is made up by Spanish companies. The regions participating in the study have an intensive level of certification, but the results cannot be applied to the rest of Europe before knowing other countries behavior in practice.

Practical implications: This study contributes in knowing what levels of integration companies can have. It can be useful in the creation of an internationally recognized guideline for integration.

Originality: This study is one of the first empirical researches about integration degrees.

Key words: Integrated Management System (IMS), ISO 9001:2000, ISO 14001:2004, Management System (MS)

Type of paper: Research paper

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Introduction

In recent years many organizations have implemented Management Systems Standards (MSS) in order to improve their management.

The most common standards implemented are those proposed by the International Organization for Standardization (ISO), ISO 9001:2000 for quality management systems (QMS) and ISO 14001:2004 for environmental management systems (EMS). For the first one, more than 897,000 companies are certified all over the world and more than 129,000 organizations are certified by SIO 14001:2004 all over the world (ISO, 2007). This EMS proposes a management system based on a PDCA model (Plan-Do-Check-Act), with certain requirements classified under 6 chapters: general requirements, environmental policy, planning, implementation and operation, checking and corrective action and management review (ISO, 2004).

This EMS has very often been implemented, in parallel or consecutively, in organizations which already used some other MS. This is usually ISO 9001:2000, generated by the same ISO, as shown in Casadesus *et al.* (2008). This standard is an MS focused on Quality Management Systems (QMS), and is based on the eight quality management principles: customer focus, leadership, involvement of people, process approach, system approach to management, continual improvement, factual approach to decision making and mutually beneficial supplier relationships (ISO, 2005). In this case their requirements are classified under five different chapters: quality management systems, management responsibility, resource management, product realization, and measurement, analysis and improvement (ISO, 2000).

These two standards together undoubtedly make up the MS which are having the most impact at global level, with more than a million certifications all over the world and a 16% increase in the last year (ISO, 2007). However, the MS being implemented in organizations which already use an EMS by no means stop here. So, for example, MS have been developed for occupational, health and safety management systems, corporate social responsibility, accountability, information systems, etc. At this point we should ask ourselves whether all these systems should be implemented individually, or whether we could benefit in some way from the possible synergies present.

In the literature we find the answer from a theoretical point of view, since all these MS, certifiable or not, can be integrated into a single MS: an integrated management system (IMS). The definition of an IMS varies, but some academics have defined them in theoretical terms. So in Karapetrovic and Willborn (1998) an IMS is defined as a "system of systems", a single system with the complete loss of the unique identities of function-specific subsystems. Later, in Karapetrovic (2003), the same concept is defined as a set of interconnected processes that share a unique pool of human, information, material, infrastructure, and financial resources in order to achieve a composite of goals related to the satisfaction of a variety of stakeholders. The most recent definition we have found is provided by Beckmerhagen *et al.* (2003), according to whom an IMS is: "a process of putting together different function-specific management systems into a single and more effective integrated management system". Combining these definitions, we can summarize

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an IMS as a process of linking different MS into a unique system with common resources aiming to improve stakeholders' satisfaction.

In fact, although IMS have been studied in detail from a theoretical point of view, there has been very little empirical research. We found only 5 relevant studies of this type (Fresner and Engelhardt, 2004; Zutshi and Sohal, 2005; Karapetrovic *et al*., 2006; Zeng *et al*., 2006 and Salomone, 2008), all of them very recent. However, they do not address the question we are about to pose here. It seems quite clear that organizations which implement an EMS must integrate it, or subsequently integrate it, with other systems: but do all organizations integrate in the same way? In other words, are all organizations fully integrating documentation, resources and procedures? Or, for example, are they integrating only some of these aspects, or even partially integrating some of them?

The main aim of this paper is to provide an empirical response to these questions. It must be borne in mind that none of the small number of earlier empirical studies is centered on this issue, which is of particular relevance, given that the majority of the organizations involved in implementation and management of an EMS find themselves involved, at one time or another, with implementing another MS in parallel.

In the next section we provide a literature review, followed by a presentation of the methodology. Empirical results are discussed in the following section and the final section sets out our conclusions.

Literature review

The integration of MS has been analyzed, from a theoretical viewpoint, from a number of perspectives. In summary, organizations wishing to implement an EMS jointly with another MS have to concentrate, in general terms, on the following aspects: integration strategies, methodology of integration, advantages and disadvantages of the IMS and degrees of integration. The main results related to each of these aspects are set out below.

Implementation strategy

The first aspect to analyze is the implementation strategy, i.e. which MS the organization is going to integrate and in what order. The most common and accepted in the literature is provided by Karapetrovic and Willborn (1998) who propose an integration based on two main MS: QMS and EMS. They propose a two-step strategy. In the first step, there are three options:

1. Integrate first QMS and second EMS
2. Integrate first EMS and second QMS
3. Integrate QMS and EMS simultaneously

Karapetrovic and Jonker (2003) subsequently proposed an integration strategy for when companies have more than QMS and EMS implemented. Based on the first option, integrating first QMS and then EMS, the sequence should be:

1. Integrate quality-related MS (process approach)
2. Integrate EMS first and then other MS based on a PDCA model

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3. Link function-specific MS; align them or make them compatible, and integrate these MS

The empirical study of Salomone (2008), based on research in Italian companies, shows how in practice a small majority of organizations implemented first QMS and then EMS (52% of the sample companies). These results are much the same as those provided by Karapetrovic *et al*. (2006) from a study of organizations in the Spanish region of Catalonia, although in this case the percentage of cases was as high as 86%.

Integration methodology

The methodology used in the integration process is another important characteristic. The methodology depends on each organization's own decision, because there is no international ISO standard to act as a guideline for the process nor any other commonly accepted reference. In this case, is should be pointed out that the Spanish standardization body, a pioneer at the global level, has developed a guideline, *UNE 66177: Management Systems. Guide for the integration of management systems* (AENOR, 2005). Based on the principle of process management, this standard provides a guide to integrating different MS, aiming to develop a global vision of the organization, improving efficiency and business performance; it is a tool for senior management to design and implement the IMS and identify methods to do so. The integration process is structured according to a PDCA model and has 3 stages: development of the integration plan, implementation of the integration plan, and review and improvement (AENOR, 2005). This guideline focuses on the integration of QMS, EMS and health and safety management systems (HSMS) because these are the most common, but it can be extended to other MS implemented or to be implemented.

As a result of the lack of internationally accepted guidelines, authors have proposed a variety of different methodologies. Karapetrovic and Willborn (1998) and Karapetrovic (2003), suggest one that includes the following steps:

1. To assess objectives regarding organization mission, design the set of processes, resources, requirements, technology, timing, etc. and their interrelation
2. To obtain resources and training, deploy resources in processes, monitor performance
3. To proceed in processing as planned, control progress and take corrective and preventive actions
4. To assess the output of individual processes against suitable criteria, and compare final output against original objectives and individual requirements and characteristics

Another model, proposed by Wright (2000), is based on 5 steps:

1. To assemble all relevant documents connected with the organization's operation
2. To note what equipment could have any bearing
3. To assess the significance of what has been identified
4. Objectives and targets set for each effect
5. Review and continual improvement

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Zeng *et al*. (2006), in an empirical research project in China, analyzed the internal and external factors that condition this IMS implementation: human resources and organizational structure are the most important internal factors, and technical guidance and certification bodies the external factors. Based on that, they propose a three-level synergetic model to enhance the integration process: strategy synergy (level 1), organizational synergy (level 2) and documentation (level 3).

Advantages and disadvantages

Once the IMS has been implemented, some studies analyzed the advantages and disadvantages of integration. Following the theoretical-based research of Karapetrovic and Willborn (1998), Beckmerhagen *et al.* (2003) and Jørgensen *et al.* (2006), the main factors are presented in table I.

Table I. Advantages and disadvantages of IMS

Advantages	Disadvantages
Simplification of requirements	Difficulties in finding common denominators
Reducing auditing and registration costs	Disappearance of unique identities
Integrated audits	Fear of job loss through amalgamation
Each organization chooses what to implement	Misalignment of operational goals
Simple transition	
Reducing costs	
Harmonization of MS documentation	
Alignment of objectives, processes, resources in different areas	
Positive for small business	
Reducing paperwork	
Synergy effects	
Elimination of effort and redundancies	
Improvement of effectiveness and efficiency	

Source: Karapetrovic and Willborn (1998), Beckmerhagen et al. (2003) and Jørgensen et al. (2006)

From an empirical point of view, the advantages and disadvantages of integration have only been considered in a small number of case studies. Specifically, Fresner and Engelhardt (2004) analyze the situation based on the analysis of IMS implementation in 2 small companies located in Austria, while Zutshi and Sohal (2005) study it based on 3 small and medium sized Australian organizations.

Degrees of integration

The final characteristic to highlight is the degree of integration. In fact, the decision as to what degree of integration an organization is going to meet depends on the organization itself. According to the literature, there is no unique model for all organizations, although academics have defined different degrees of integration.

Table II summarizes all the models found, grouping into 4 levels those aspects which (disregarding the differences involved) indicate approximately the same thing.

Table II. Degrees of integration according to the main authors

Integration Degrees	Wilkinson & Dale (1999)	Karapetrovic (2002)	Karapetrovic (2003)	Beckmerhagen *et al.* (2003)	Pojasek (2006)	Jørgensen *et al.* (2006) & Jørgensen (2007)
Level 0	Individual MS				Combined	
Level 1	Combination based on linkages	Documentation integration	Partial Integration	Harmonization	Integratable	Correspondence
				Cooperation	Integrating	Generic
Level 2	Integration of selected parts without linkages	Alignment of core processes, objectives, resources				

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Level 3	Integration of systems certificated and uncertificated	"All-in-one" system	Full Integration	Amalgamation	Integrated	Integration

Source:Own elaboration from the literature

The first authors to deal with this subject were Wilkinson and Dale (1999) and Karapetrovic (2002), describing quite similar levels of integration, as shown in the table above. So according to Karapetrovic (2002) three types of organizations can be found: those which have integrated only the documentation, those which have aligned the processes, aims and resources and finally those which have all parts of MS integrated in a single MS. The process is summed up in Karapetrovic (2003) where two levels are defined: (1) partial integration: this level can range from a simple collaboration to alignment and harmonization of objectives, processes and resources of separate MS and (2) full integration: constituting systems lose their unique identities, resulting in complete integration to a single multipurpose IMS. Finally, a very similar idea is presented in Beckmerhagen *et al*. (2003). These authors argue for three degrees of integration, defined as follows:

1. Harmonization: organizations have integrated the documentation at a partial level. This could mean two things: companies have partially integrated either some of the documentation regarding MS or all of it.
2. Cooperation: organizations have partially integrated the documentation, internal audits and resources. This degree of harmonization goes one step further, because companies have integrated internal audits and human resources, which are considered important elements in the integration process.
3. Amalgamation: this takes place when full integration of documentation, resources and procedures is achieved.

In the same way, they label each of the levels, in accordance with the British Standards Institution (BSI) classification. According to Pojasek (2006) the degrees are:

1. Combined: separate MS are used at the same time in the same organization
2. Integratable: identification of common elements
3. Integrating: integration of common elements
4. Integrated: one system incorporating all common elements

Finally, Jørgensen *et al*. (2006) and Jørgensen (2007), define three different levels of integration. These are: (1) correspondence – cross references and internal coordination, (2) generic – understanding of generic processes and tasks in the MS, and (3) integration – creation of a culture of learning, stakeholders' participation and continuous improvement.

Bearing in mind that the main aim of this paper is to establish the degree to which companies integrate their EMS with other MS, and that we have not detected any empirical research focused on this area, this work will be the first empirical contribution in the field. Thus it will analyze the extent to which the various levels of integration proposed make sense in reality, and what these levels really include.

Methodology

The objective of this paper is to study to what extent companies integrate their MS already implemented. In order to do so, we carried out an empirical study in Spain, one of the

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countries with most ISO 14001:2004 and ISO 9001:2000 certifications at global level (ISO, 2007). Specifically, in the case of ISO 14001:2004, Spain is in third position, after Japan and China, while in the case of ISO 9001:2000 certifications it is fourth after China, Italy and Japan (ISO, 2007).

In order to answer the questions posed, in February 2006 a questionnaire was sent to 1,615 companies that have, at least, EMS and QMS implemented in accordance with ISO 14001:2004 and ISO 9001:2000 respectively. This was sent to organizations located in those Spanish autonomous communities with the most intensive levels of certification (see Heras and Casadesus, 2006), addressed to the MS managers of the organization. Details of the fieldwork are set out in Table III.

Table III. Survey information

	Spain
Study date	February 2006
Study population (approx.)	2,706
Study sample	1,615
Number of responses	435
Response rate	27%
Confidence level (p=q=0.5)	96%

Source: Own elaboration

Responses were received from 435 organizations, representing 27% of the sample. The survey had 16 different sections, based on aspects such as the reasons for non-integration, MS already implemented in the organization, tools used in the integration process, the main difficulties faced in this process, integration of internal and external audits, the future of certifications, etc. Most of these aspects go beyond the specific aims of this article, but a descriptive analysis of the answers obtained can be found in Karapetrovic *et al*. (2006).

As to the degree of integration of MS implemented within these organizations, as shown in Figure 1, these were self-classified into 14% of businesses which did not integrate their MS, 7% which did so partially, and 79% which did so totally. This first classification of the level of integration of MS was based only on a simple direct question to each organization.

Figure 1. Integrated standardized management systems
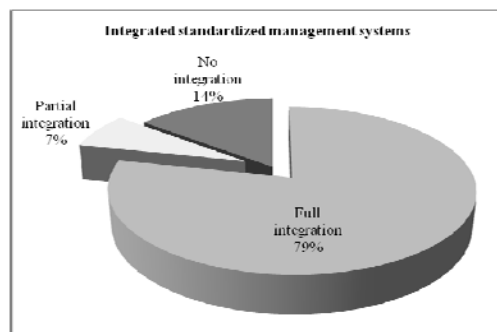
Source: Own elaboration

The in-depth analysis of the remaining data obtained from the survey shows us to what extent these responses coincide with reality. In order to achieve this, we included questions related to degrees of integration specific to each of the elements which, according to

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Karapetrovic and Willborn (1998), are susceptible to integration: resources, goals and processes.

According to the definitions of ISO 9000 (ISO, 2005), goals or objectives are something sought or aimed for, in this case, related to quality; a process is a set of interrelated or interacting activities which transforms inputs into outputs; and resources, although not defined by ISO 9000, could be defined as goods used as factors for a process in order to obtain other goods to satisfy human necessities. In an IMS the goals are common for all MS and are the first aspect that needs to be integrated (Karapetrovic and Willborn, 1998; Karapetrovic, 2003; Karapetrovic and Jonker, 2003). Processes are interconnected and use the same pool of resources (Karapetrovic, 2003).

These three main elements of the integration process are the basis for the question studied here. The first group of questions was related to the integration of resources, given that it is important to know to what point the human resources involved are integrated or not. That is, whether or not the responsibility for managing EMS falls to the same person who manages other MS. This aspect was analyzed taking into account three different levels of responsibility: top management, asking for the executive, functional level, asking for the organization representative, and shop-floor, asking for the inspector of the various MS.

The second group of questions, related to goals, was focused on the degree of documentation integration. Specifically, we wished to learn whether or not they had integrated the documents which are indispensable to an MS, such as the objectives, policy, manual, procedures, instructions and records.

Finally, with reference to processes, we analyzed the extent to which common procedures were integrated between the EMS and other MS. We asked, for example, about the degree of procedural integration for document and record control, product realization, internal auditing, etc.

Following a descriptive analysis of the data obtained, further multivariate analyses were carried out: multiple correspondence analysis (MCA) and a cluster classification. The MCA was carried out in order to minimize the qualitative information into few quantitative axes to help in the interpretation of the data (Bénzecri, 1973; Greenacre, 1993). The cluster analysis was done to group the organizations, with the aim of discovering the different types according to their degree of integration. The results are presented in the following section.

Results

The sample analyzed was made up of 362 companies which claimed to have some level of integration, specifically 86% of companies in the sample whose MS were partially or fully integrated. Thus those companies that do not integrate any of their MS were not considered further in this study.

The question studied in this paper, as previously mentioned, is divided into three parts: human resources, documentation and procedures. A preliminary descriptive analysis considers each of these aspects separately.

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Figure 2 shows the personnel involved in the integration process. At all three hierarchical levels it is most common to have different people involved in the process, although inspectors always make up the lowest percentage. If we bear in mind that the great majority of companies consider their systems to be fully integrated, the results obtained do not agree with those of Karapetrovic (2002), according to whom a level of integration was expected for all hierarchy levels. It is clear that there is a large percentage of organizations, almost half of the cases, which may have the various MS integrated in many respects, but not in those related to human resources at any level.

Figure 2. Integration of human resources
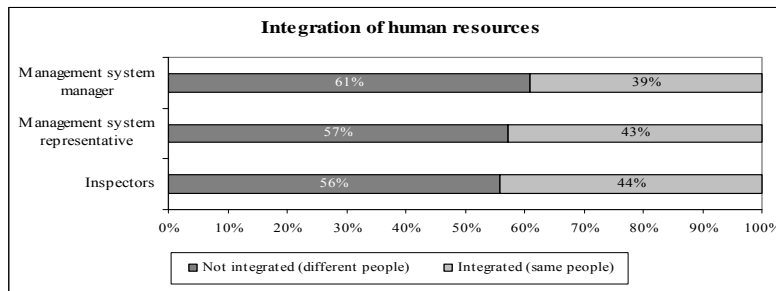
Source: Own elaboration

Regarding documentation integration (figure 3), the majority of companies have all the items measured fully integrated, although the frequency is considerably higher for the organization's policy, objectives and manual. Records and instructions have a lower frequency of full integration. This undoubtedly shows that the first documentation to be integrated is that which relates to the most strategic areas of the management system, moving on later to that which relates more to operations. These results, however, are clearly aligned with the findings of Karapetrovic and Willborn (1998), Winder (2000), Karapetrovic (2002) and Jørgensen *et al*. (2006), according to whom integrating policy and objectives is the first step for the implementation of an IMS.

Figure 3. Integration of documentation
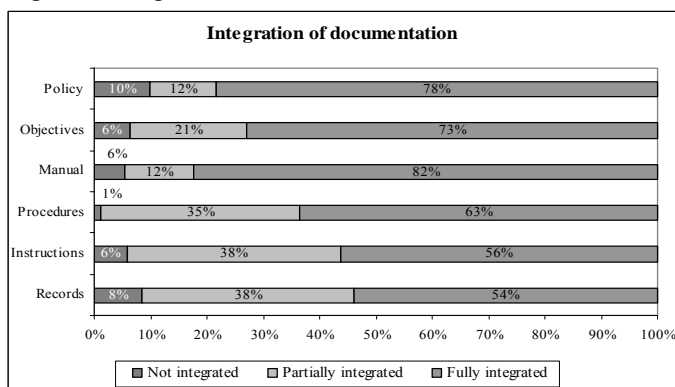
Source: Own elaboration

Finally, figure 4 presents the frequency of integration of procedures. It can be observed that the majority of companies have 4 of the procedures under study mostly integrated: internal audits, management review, document and record control and internal communication.

If we take into account that all these procedures can be classified under the different requirements of ISO 9001:2000 (ISO, 2000), i.e. following the sections of the standard in

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quality management systems (Chapter 4: control of documentation, record control), management responsibility (Chapter 5: planning, management review, internal communication), resource management (Chapter 6), product realizations (Chapter 7: product realization, determination of requirements) and measurement, analysis and improvements (Chapter 8: internal audits, control of nonconformities, preventive and corrective action, improvements), it is easy to see in the above figure that procedures related to product realization are the least integrated while procedures related to measurement, analysis and improvements have a higher degree of integration. Again, using the analysis of another element, we reach a similar result to that obtained in the case of human resources involved: procedures which relate to the more operational aspects, such as those related to product realization (Chapter 7 of ISO 9001:2000), are the last to be integrated. Those which could be considered more strategic are integrated first, possibly because of the greater difficulty in standardizing each organization's operational working procedures.

Figure 4. Integration of procedures
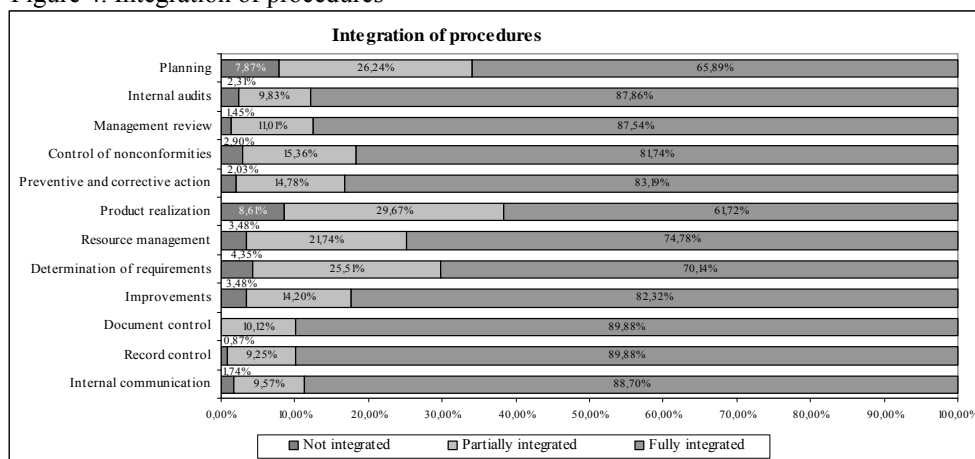
Source: Own elaboration

Multiple Correspondence Analysis

In order to facilitate understanding of the results of the study with a smaller number of variables, a Multiple Correspondence Analysis (MCA) was carried out. For the MCA, the 21 original variables were ordered into a matrix: 3 variables ask about the people involved in the process, 6 about documentation and 12 about procedures. The data processing produces 2 quantitative axes (extracted factors), explaining 80% of the total variance. Each axis is explained by a number of variables which make the greatest contribution to that axis. The contribution or percentage of a variable in an axis depends on the number of variables and the percentage values. The minimum percentage of contribution in order to take a variable into account is 3% in this study. Table IV sets out the contribution of each variable to each axis, with those which form part of each axis shown in bold.

The first axis represents a partial degree of integration, because all the main contributors are variables at this level of partial integration. The second axis, summing up the information of the original data, represents a full degree of integration because the variables that most contribute to its creation are from this level of full integration. These degrees of integration coincide fully with the classification in Karapetrovic (2003): partial and full.

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Axis 1 can provide us with an idea of which aspects are important in organizations which only partially integrate their MS, given that this axis, explained by a total of 10 variables, is formed only by variables which represent a partial level of integration. Apart from integration of the organization's policy, the variables that most contribute are related to procedures, specifically those of documentation control, preventive and corrective action, control of nonconformities, record control and improvements. Under careful analysis, it can be seen that the majority are related to chapters 4 (quality management system) and 8 (measurement, analysis and improvements) of ISO 9001:2000. That is, once again we see that those organizations which partially integrate do so mainly in the more strategic aspects of the organization, leaving the more operational areas such as "product realization" until later.

Table IV. Variables contributing to the creation of each axis.

		Axis 1			Axis 2		
		Not integrated	Partial integrated	Fully integrated	Not integrated	Partial integrated	Fully integrated
Human Resources	Management system manager	0.04%	-	0.09%	0.39%	-	0.08%
	Management system representative	0.05%	-	0.07%	0.16%	-	0.09%
	Inspectors	0.14%	-	0.24%	0.14%	-	0.27%
Documentation Resources	Policy	0.23%	**3.30%**	0.76%	0.45%	0.43%	**6.23%**
	Objectives	1.13%	1.44%	0.90%	1.44%	2.14%	2.72%
	Manual	1.86%	2.91%	1.02%	1.70%	**3.52%**	**5.50%**
	Procedures	0.05%	**3.42%**	2.03%	1.93%	0.10%	**6.47%**
	Instructions	0.05%	0.46%	0.18%	**3.85%**	0.09%	0.88%
	Records	1.32%	1.77%	2.51%	0.35%	2.50%	**3.35%**
Procedures	Planning	1.37%	1.91%	1.60%	**4.74%**	2.60%	3.61%
	Internal audits	1.52%	**3.18%**	0.63%	**3.03%**	2.88%	**6.02%**
	Management review	0.15%	**3.94%**	0.62%	1.20%	0.28%	**7.44%**
	Control of nonconformities	1.43%	**4.68%**	1.35%	1.18%	2.71%	**8.86%**
	Preventive and corrective action	1.74%	**5.06%**	1.32%	2.54%	**3.29%**	**9.57%**
	Product realization	1.95%	1.96%	2.12%	2.50%	**3.68%**	3.71%
	Resource management	0.32%	2.30%	0.90%	**4.01%**	0.60%	4.35%
	Determination of requirements	2.05%	**3.48%**	2.19%	1.70%	**3.88%**	**6.59%**
	Improvements	2.80%	**4.16%**	1.41%	**4.15%**	**5.29%**	**7.87%**
	Document control	0.00%	**6.45%**	0.72%	0.00%	2.66%	**12.19%**
	Record control	0.92%	**4.33%**	0.58%	1.37%	1.75%	**8.18%**
	Internal communication	1.48%	2.88%	0.52%	1.10%	2.80%	**5.46%**

Source: Own elaboration

The second axis defines organizations which fully integrate the various MS which have been implemented. This is defined by 16 variables, the majority in a full degree of integration. The greatest contributors are those variables related to procedures, as in the first axis and are, in order: document control, preventive and corrective action, control of nonconformities, record control, improvements and management review. Four variables related to documentation are fully integrated: procedures, policy, manual and records. As in the other axis, the people involved do not contribute to the creation of this axis. It should be noted that in this axis there are some variables that are not integrated or are integrated at a partial level. Although they are taken into account, the greater contributions are related to full integration and we use these as the variables to define of this axis.

One of the most important aspects of this analysis, which can be seen in the table above, is that in neither of the two axes do we see any variable related to human resources forming part of the main axis. This indicates that the integration of these resources does not affect

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the level of integration of the systems that have been implemented. To put it another way, whether the system is partially or fully integrated, the human resources which manage it may be the same or different for each of the systems concerned. No differences are detected with respect to these resources. This aspect, which does not correspond with the findings of the main theoretical studies (e.g. Karapetrovic, 2002) means that the possible integration of these resources will not be taken into account in the following sections.

Cluster classification

In order to classify the organizations into different groups, to discover the nature of the integrating companies, we used the 2 axes resulting from the MCA as original variables for this analysis. We measured the similarities or dissimilarities between individuals using distances, applying hierarchical methods (Johnson, 1967) because our objective was to group all individuals into a small number of groups. To detect outliers that might condition the classification, we applied the single linkage method (Sneath, 1957) and 3 cases were eliminated (n=359). The method used to obtain the groups was the Ward method (Ward, 1963), because is one of the most robust methods and because it creates homogeneous groups with minimum variance. The result was a 3 group classification. To verify whether the relation between the classification and the axes is strong enough to consider the classification to be acceptable, the mean of the eta square (η^2), measure of relation must be high. In our case, the mean is $\eta^2 = 0.655$, which is acceptable.

Figure 5. Group classification
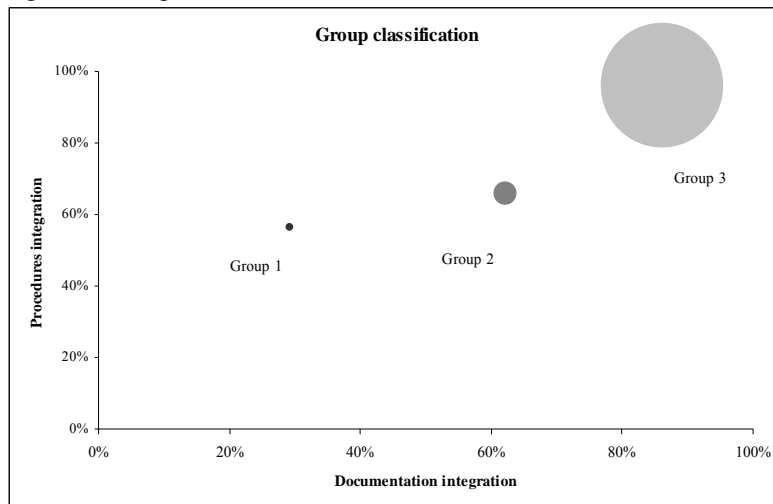
Source: Own elaboration

Figure 5 shows the 3 groups obtained. In order to make it easier to understand and to be able to adjust it to the elements integrated by the companies, rather than defining them and showing them in functions of the axes detected, we have represented them by two different axes: level of documentation integration and level of procedural integration are the aspects which contribute to the creation of the two axes. These new axes account for 79% of the variance, slightly less than in the previous section but nevertheless very significant. In order to find out the contributions of documentation and procedures in each group, we used a percentage codification in which organizations which claimed to have partial integration of documentation or procedure were taken to be 50% integrated. This aspect of the work is not entirely rigorous, since the organization might have partially integrated at a level of 60% or 40%, for example. However, given that what we were aiming for was a simple,

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graphical representation of the relative importance of each of the groups detected; this does not have too much effect on the results. In this same Figure, the surface area of each cluster is represented in function of the number of companies which make up each group.

The first thing one notice in Figure 5 is the formation of three separate groups, which we will call according to the names given to them by Beckmerhagen *et al.* (2003): harmonization, cooperation and amalgamation, given that, as will be seen in their description, the results are very similar to those definitions. The characteristics of each group are described below.

Group 1: Harmonization

In this group there are only 8 companies, representing 2% of the sample. Organizations in this group have partially integrated their documentation and procedures, possibly at a level equivalent to the harmonization level defined by Beckmerhagen *et al.* (2003). This group is not homogeneous, in the sense that in some respects the 8 organizations behave in a very different way from one another and cannot be jointly defined, as is the case for the other groups. This is a result of the relatively low level of importance of this group and therefore the small number of companies which make it up; as a consequence, all the data here must be analyzed with caution.

Documentation is integrated at an average level of 29% while procedures are integrated at 56%. The difference between these two averages is considerable and it can therefore be claimed that these businesses pay more attention to integration of procedures than documentation.

The most highly integrated documents are procedures in general (50%), management system policy (37%) and operating instructions (33%). Objectives are 25% integrated records 13% and, finally, the least integrated item is the management systems manual. These results are not particularly logical if one takes into account the pyramid structure of standard management systems. The cause is evidently the low number of companies which make up this group.

As for procedures, those with the highest level of integration are record control, which is fully integrated, management review (94%), resources management and internal communication (81%), internal audits (75%) and documentation control (69%). The remaining procedures have a level of integration below 45%. In this case we see similarity to the chapters of ISO 9001:2000 (ISO, 2000), since chapters 4, 5, 6 and 8 are the most integrated. As noted in the descriptive results, procedures related to chapter 7 are the least integrated.

Group 2: Cooperation

This group is made up of 41 companies representing 11% of the sample. Companies in this group have a medium level of integration, making them equivalent to the second level proposed by Beckmerhagen *et al.* (2003): cooperation. Procedures in this group of organizations are integrated at a slightly higher level than documentation, with documentation at 62% and procedures at 66%. However, as these percentages are very similar one can conclude that on average, management systems are integrated by more than 62%.

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In documentation, the most integrated items are policy (78%), objectives (66%) and the manual (67%), while procedures are 58% integrated and instructions and records 55% and 53% respectively. It can be noted in this case that the results do make sense, if we take into account the documentation pyramid of management systems. At the first level of the pyramid we find objectives and the manual, which are the most integrated aspects, procedural documents, are lower and finally instructions and records, which form the final level, are the least integrated. This shows once again how organizations begin to integrate management systems, starting with the more strategic aspects, slowly moving towards tactics and finally to operations.

For procedures, the most integrated are internal communication (74%), internal audits (71%), management review, resources management and documentation control (70%) and improvements and records control (66%). As in group 1, procedures corresponding to chapters 4, 5, 6 and 8 of ISO 9001:2000 are those with a higher percentage of integration, while those in chapter 7 are least integrated. This confirms the findings in the descriptive results shown earlier.

Group 3: Amalgamation

The group is made up of 310 companies representing 87% of the sample, the largest by far of the groups identified. Companies in this group are characterized by a high degree of full integration, placing them within the definition of amalgamation provided by Beckmerhagen *et al.* (2003). These organizations have, on average, documentation integrated at a level of 86% and procedures at 96%.

The documents most integrated are policy and objectives (87%) and the management system manual (94%). Procedural documents are integrated at 86%, while instructions and records are at 78%. These results, like those of the previous group, correspond with what could be expected, given the structure of the documentation pyramid.

As for procedures, these are integrated at a level of 96%. The most integrated are document and record control (99%), internal audit, internal communication and preventive and corrective action (97%), management review and improvements (96%) and control of nonconformities (95%). It can be noted that the procedures corresponding to chapters 4, 5 and 6 of ISO 9001:2000 are those with the highest level of integration. As noted in the other groups, those from chapter 7, which are more difficult to integrate have a lower level of integration, even though it is very high in this group.

Conclusions

Many organizations need to implement a MS, such as QMS and an EMS jointly, in parallel or sequentially with another MS. When this happens, there is the option of integrating all the systems in a single IMS. Thus the aim of this study is to discover the degree of integration within companies. In order to do so, an empirical study was carried out on more than 400 companies which are certified under both the environmental management standard ISO 14001:2004 and the quality management standard ISO 9001:2000.

From the results obtained we can conclude, first, that there are a great number of companies (86% of the sample) integrating their MS at various levels. Secondly, the results

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are aligned with the classification by Beckmerhagen *et al*. (2003), confirming the existence of 3 groups of organizations in function of the degree of integration of the various MS implemented. Of these 3 groups a clear majority, 87% of organizations which integrate management systems, carry out full integration of the systems. Only 11% carry out partial integration (more than 60% of procedures and documentation integrated), and a very low 2% integrate their systems to a very low degree.

As well as confirming the existence of these different groups, it is also quite clear from the data that organizations follow a pattern regarding the documentation and procedures they integrate the most. It seems clear that they begin with the most strategic documents and procedures (policy, objectives and manual in the case of documents, and record control, internal audits and internal communication for procedures), integrating tactics and operations later on.

There is, however an element confirmed in our research which differs from what is claimed in the theoretical literature: the role of the people involved in integration of management systems. In our study this variable is not significant for either partial or full integration. That is, there are no differences between the involvement of personnel in MS in function of the level of MS integration. This would confirm, for example, that the responsibility for the environmental and the quality management systems often falls on the same person, even though the systems are not integrated, or even that two different people may manage integrated systems. Karapetrovic (2002) suggests that the hierarchy level is related to the degree of integration, but this could not be compared in our study.

For future research, given the large number of companies with implemented MS integrated within a IMS, it would be interesting to discover what difficulties they face during the integration process and, particularly, whether the implementation model followed conditions the process. Neither of these two characteristics of IMS has been compared empirically.

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The Wuppertal Generic Management System Concept
– an approach concerning requirement related design of enterprises

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Abstract
The complexity of the global economic processes has increased enormously and the demands of different stakeholders on practicable management systems have increased as well. Tasks and demands are more and more complex and the boundaries of systems expand. The problem is to combine different demands and different management systems and to create a method which can be handled easily.

Purpose
This paper offers an approach how to join different demands and requirements of different stakeholders by just one management system. This concept is called the WGMC – the Wuppertal Generic Management Concept.

Methodology
This concept is based on the hypothesis that an enterprise needs one all-embracing, holistic management concept. We developed a new methodology. It offers the opportunity to realize and verify an effective solution of the described problems.

Research Limitation
The theoretical approach of the generic management concept is based on a module structure. These modules have to be defined and described. A lot of research work has already been done, but there are still fields of research to continue. It has to be mentioned that this approach needs more research work to develop a practicable and easy to handle tool.

Originality/Value of paper
The theoretical approach of the Wuppertal Generic Management Concept leads to a dynamic and sustainable management concept. It presents a real-time operating system. It is a holistic and ubiquitous concept.

Keywords: systems engineering, sustainable, generic concept, holistic

Category: Research Paper

Introduction and Purpose

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The world today is ruled by global requirements, demands and availabilities. Tasks and demands become more and more complex. The boundaries of the different systems expand and it becomes more complicated and complex to define them. The number of stakeholders has drastically increased, too. So the mutual dependences and interdependences between different requirements on products and enterprises are huge and complex.

The enterprises need instruments which enable them to determine the variety of requirements systematically and to fulfil these requirements. The problem itself -to identify the requirements before the task of generating a product is defined- is not new at all. But the not just the number of requirements have increased, the requirements themselves have changed and enterprises nowadays have to listen to all requirements they have to fulfil all of them (Erlenspiel, 1995; Seghezzi, 1997; Bleicher, 2001). The structure and design of enterprises have to meet the requirements, and the generic philosophy can offer an approach of solution.

Methodology

The generic management philosophy is based on the systems engineering approach (Winzer, 2004). Systems engineering itself is a well known discipline offering possibilities to develop systematic problem solutions (Arlt 1999). The methodology is based on the systems philosophy. Everything surrounding us even including us can be described by a system, having system boundaries on the one hand and dependencies and interdependencies on the other hand. This means that the approach is a general holistic method of system based thinking and that it is ubiquitous suitable.

Haberfellner (1994) has already shown that it is not necessary to find a specific problem solution for each specific problem. His holistic approach is established on two parts: a thinking model, which has to be developed, and an operating method, which is derived from the thinking model.

The thinking model, the system approach comprehends the system with all its elements, dependencies, interdependencies, and its organization as a structure. The operating model describes the principles of design and the general methods of conversion and realization.

This basic approach provides a basis for describing a complex world out of requirements and processes. But the point of view on this complex system seems to be comparatively static. To take as an example: the description and definition of problems is a static input into the system. This input is conclusive and definite and it will not be changed during the process of problem solution. Requirements, demands and problems themselves are dynamic and need a dynamic model. Therefore the Wuppertal Generic Management Concept was developed.

Generic System Concept

Sitte/Winzer (2004) have modified the approach of Haberfellner (1994). This modified approach sticks to the same thinking model as Haberfellner, but a new operating model has been developed. The approach of Sitte/Winzer consists of three parts. Part one includes the description of the system, part two comprehends the steps of the system design, and part three contains the combination of steps of the system design.

After a focusing of interests the first step is to identify the system at which the problem could be accumulated; this step is not depending on the specific details of the problem – this is a contradiction to the approach of Haberfellner. The system has to be characterized and defined. The impact of the different steps is shown in figure 1.

Figure 1: System-Engineering-Approach by Sitte/Winzer (2004)

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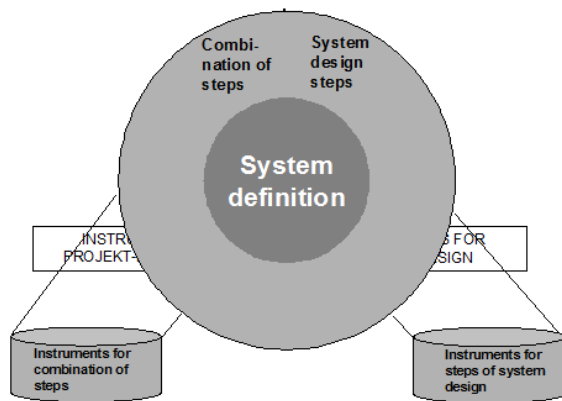
This first step includes die characteristic of the system, its classification in subsystems and elements, its hierarchy, the dependencies and interdependencies between subsystems and elements and as well between system and environment.

The next step is to describe the system design. The system design includes the process of goal definition, the process of analysis and the process of design.

First of all the demands and requirements have to be collected as a goal definition.

In the frame of the known system boundaries the demands and requirements have to be clustered to be able to evaluate and to minimize them. This is the process of analysis.

Having the knowledge about dependencies and interdependencies between subsystems and elements an efficient design concerning the goal definition can be done. Figure 2 shows the systematic of system design steps and combination of steps.

Figure 2: Systematic of System Design Steps and Combination of steps
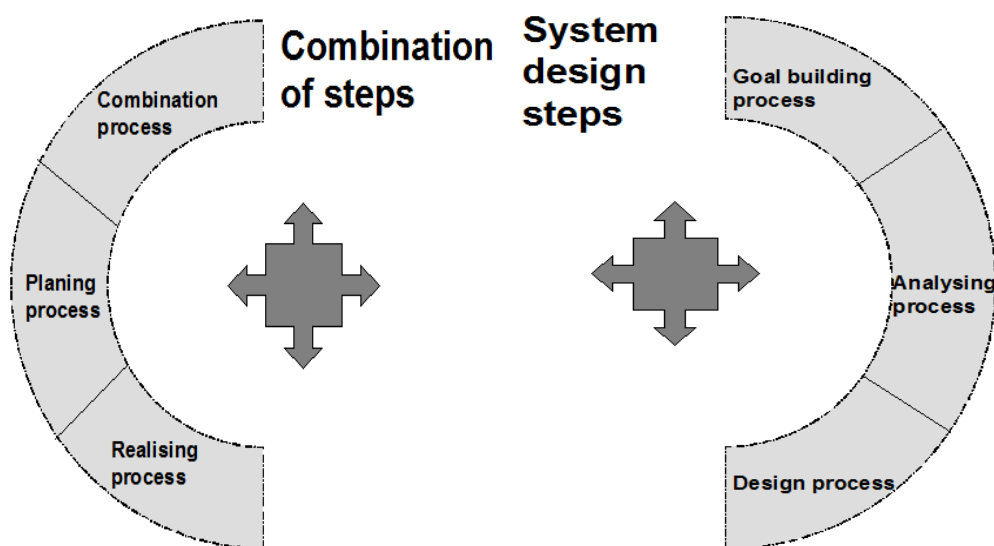
At this point the third step of the generic systems engineering concept starts: the combination of the so far existing steps.

In the context of a planning process the combination of the steps of the system design is carried out to realize an efficient and reality close problem solution.

This procedure is dynamic because it is on the one hand based on first existing results out of step two concerning to the problem description and on the other hand it can take new requirements and demands into account (see figure 2). The figure seems to show a linear process, but the process itself is comparable to a goal orientated 'random generator'. This means

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that the choosing of a method or an approach is not defined rigorously but it attends to the specific conditions and circumstances of the problem.

While the selection of methods and benchmarks in the system design steps aimed to find a problem oriented solution the third steps includes such questions like: In which order different methods should be combined or which resources are needed and offered or which controlling and monitoring instruments are necessary.

As a conclusion of the generic systems engineering concept -including the three main components of system definition, system design and combination or arrangement of system design steps- offers a general and ubiquitous way to find a problem solution. At the same time the operating model –including the phases of system design on the one hand and combination or arrangement of design steps on the other hand- offers the potential to work out problem specific methods and approaches.

Accordingly this ubiquitous approach leads to an orientation on the essential questions. The individual solutions start at step three when searching for an arrangement and a combination of design steps for a detailed specific problem.

Generic Management Concept

In everyday life enterprises have to solve many problems being quite complex. The reality never offers just one problem. Nevertheless the generic systems engineering concept can be used to get one system as a thinking model and one operating model. The operating model includes goal orientation, analysis and design. These components of the operating model are typical and general for management concepts.

Concerning the systems engineering approach an enterprise can be considered as a system. The system design in an enterprise is a permanent dynamic task. The generic management system philosophy offers the chance to produce a demands and requirements oriented design of enterprises. This management system is sustainable. Figure 3 shows the combination and sequence of phases and steps to implement the generic management concept into an enterprise (Sitte/Winzer 2004).

Figure 3: Steps of Design according to Sitte/Winzer 2004
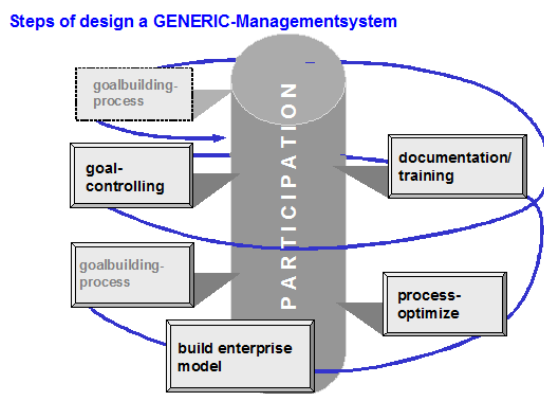
This process of design has to go along with the high grade of quality meaning the high grade of compliance with the requirements. The definition of quality in general is the definition of the grade of compliance with the requirements. To get a high grade of quality requests the determination and identification of requirements and demands. If requirements and demands are not determined, they will not be achieved and fulfilled. This leads to a quality deficit.

The diversity, plurality and variety of requirements and demands in enterprises is increasing. Standards to handle and cope with these requirements and demands have been developed like DIN EN ISO 9000/2000ff or DIN EN ISO 14000 ff.

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When implementing the generic management method into an enterprise the first step is analogue to the description being given at the generic systems engineering concept: to focus on the system. This means to define whether the enterprise itself, a part of the enterprise or even the enterprise network should be involved in the process of design.

The second step is the definition of goals. Therefore the requirements and demands have to be archived and identified, they have to be clustered, evaluated and benchmarked. This leads to enterprise specific goal definitions.

The next step is a rough analysis to check up on the description of the organization of the operating sequence and design of the enterprise. The description of the subsystems and their dependencies and interdependencies has to be proven.

If there exists any insufficiency a basic model of the characteristics of the enterprise has to be developed. Therefore all subsystems and all dependencies and interdependencies of the system have to be comprehended.

This basic model is essential to do a deeper analysis concerning different subsystems in further steps to work out the grade of compliance with requirements and demands and to develop measures to get better compliance.

When the step of system design of enterprise is finished the results have to be documented (see figure 4), this is known as management system documentation. This documentation is essential to visualize the different kinds and ways of dependencies and interdependencies.

The following step of the shown spiral, which is like a formed mat, is the goal controlling; the status of goal compliance is proven again, new requirements and demands can be established and there grade of compliance can be checked.

This leads to a holistic process of controlling which guarantees the sustainable development of the enterprise. This general method of systems engineering is flexible in itself and offers the opportunity of a dynamic development. This coherence is shown in figure 4.

Figure 4: Dynamic of Generic Systems Engineering Concept according to Sitte/Winzer 2004/2.
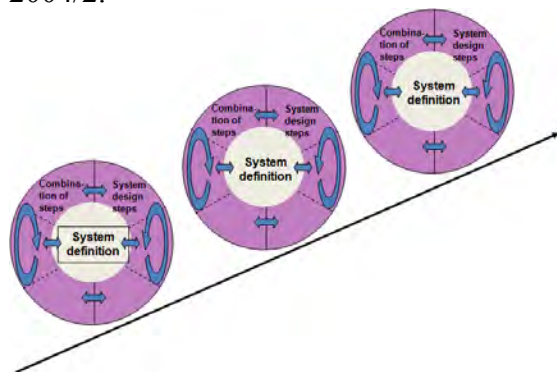
This dynamic approach out of the systems engineering can be transferred to the method of a generic management system in general. Just enterprises which offer a dynamic establishing and compliance of requirements and demands will have a sustainable development and be successful at the worldwide market.

To summarize the results so far, it has been explained and illustrated that the generic management system concept as a method pursues the goal to systematize the process of enterprising with its holistic components and to combine it with an accordant management system. Therefore the total quality management concept is a part, a subset of the generic management concept.

Results of the Wuppertal Generic Management Concept

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To make the application of the generic management system more obvious this chapter offers a description of the different modules of the concept.

The concept is based on planning, realization, controlling and advancement; those are the pillars of all management concepts. But the Wuppertal generic management concept additionally is an open, dynamic and requirement and demand oriented system based on a holistic process oriented design concept.

The model of this ubiquitous management concept is modular. Actually it is based on seven modules (Scharn 2007).

Figure 5 shows the system model of the Wuppertal Generic Management Concept with its seven modules.

Figure 5: 7 Modules
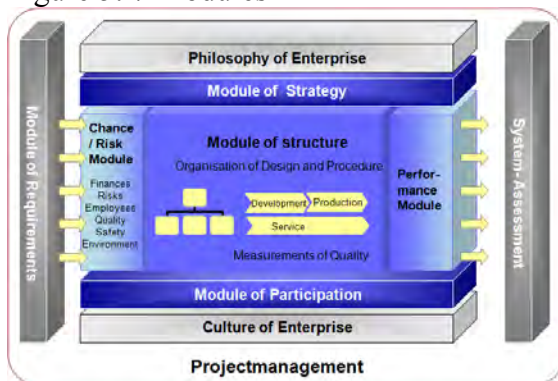
Table 1 lists up the different modules and their tasks according to Scharn 2007.

Table 1: Seven Modules of WGMC _____

Module	Task
Module of Requirements	gathering, systematization and evaluation of all requirements
Module of Chance and Risk	the requirements are valued to identify and quantify fields standardized risks
Module of Strategy	a complete process of strategy is passed through to gather the strategic orientation of the enterprise
Module of Structure	systematized requirements are transformed into reality
Module of Participation	process of changing designed as a win-win situation
Module of Performance	measuring the efficiency of processes and organization
Module of System Assessment	

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> continuous controlling of a requirement oriented design of proc-
> esses

To verify the WGMC in enterprises the common methods of project management are used. The deeper development of the different modules is the topic of many doctoral theses. The thesis of Reiche 2007/2 deals with the module of participation to cope with modifications. Some of the most interesting results are presented in this chapter, too.

The module of participations is based on the estimation of barriers and essential fields of activity. The four parameters 'knowledge, ability, volition, and permission' are gathered by twelve participation factors, by using a questionnaire. The three levels of employees, management and enterprise are taken into account to analyze the barriers of participation.

Figure 7 Module of Participation concerning to Scharn 2007
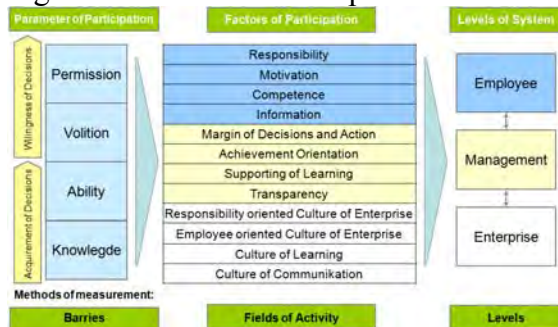
This module of participation offers a consistent process to deal with various changes. The different steps of this process consist in the determination of the actual status, in the definition of goals, in deducing the future state, up to the selection and use of appropriate methods and tools.

Last step is the evaluation of the whole process.

Conclusions and limitations of research

The Wuppertal Generic Management Concept is a theoretical approach to build up a sustainable management concept which is dynamic and presents a real-time operating system. Explained by specific problems out of the reality of enterprises it shows its holistic und ubiquitous concept.

It has to be mentioned that this approach needs more research work to develop a practicable and easy to handle tool.

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A Generic Management Concept
– a way of sustainable design of enterprises

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Abstract:

Global economic processes are complex and their complexity is increasing. Tasks have to be solved by interdisciplinary approaches and by interdisciplinary teams. Having demands on interdisciplinary work groups leads to the necessity of having just one language to communicate. Language at this point is defined as a kind of methodology to work. Different disciplines refer to different languages. To use just one language is absolutely necessary because contributors can not know all languages and methods of all disciplines. One interdisciplinary language is the systems engineering approach therefore it is taken up again. This paper shows a further development of the systems engineering approach. This advancement leads to new approach including a dynamic model – the Wuppertal Generic Management Concept. The term of quality was defined and filled with substance by DIN EN ISO 9001, Quality Management Systems were defined as well. Concerning an increasing of the holistic and general considering of the customers requirements the Total Quality Management Systems have been developed (EN ISO 9004) and as a logical further development the Generic Management System approach was generated. The Wuppertal Generic Management Concept takes all requirements by all stakeholders into account having the purpose to create a requirement related design of enterprises. Two examples of application out of the field of safety and appropriation of drinking water on the one hand and keeping hot liquid on the other hand illustrate and amplify the theoretical scientific approach. The paper offers a solution to combine different requirements and different management systems and to create a new method which can be handled easily – the Wuppertal Generic Management Concept.

Purpose

This paper offers an approach how to join different demands and requirements of different stakeholders by just one management system. The approach is accentuated by two different examples.

Methodology

This concept is based on the hypothesis that an enterprise needs one all-embracing, holistic management concept. We developed a new methodology. It offers the opportunity to realize and verify an effective solution of the described problems and shows a possible application.

Research Limitation

The theoretical approach of the generic management concept is based on a module structure. These modules have to be defined and described. A lot of research work has already been

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done, but there are still fields of research to continue. It has to be mentioned that this approach needs more research work to develop a practicable and easy to handle tool.

Originality/Value of paper

The theoretical approach of the Wuppertal Generic Management Concept leads to a dynamic and sustainable management concept. It presents a real-time operating system. It is a holistic and ubiquitous concept.

Keywords: systems engineering, sustainable, generic concept, holistic

Category: Research Paper

Introduction and Purpose

Tasks and demands are ruled globally today, they are described holistic and they have to be solved by interdisciplinary teams. These different contributors need a basis to communicate concerning their methods and methodologies. Systems engineering is a well known approach which is applied over all disciplines. Systems engineering offers possibilities to develop task solutions systematically (Arlt 1999, Winzer 2003, Hoeborn 2008). Originally systems engineering had been a holistic approach concerning all disciplines later on it had been split into certain special fields like safety systems engineering or software systems engineering. Our methodology starts at the original approach of systems engineering.

Methodology

The methodology of systems engineering is based on the systems philosophy. The word system is used frequently in technical and even in ordinary speech to refer to an entity of some kind that is the focus of interest. Depending on our interest, almost anything can be defined as a system, for example: the engine of a car, a city, the economy of a nation, a company, the earth atmosphere, a colony of birds, a molecule, a gas filled balloon, etc. This shows that a system is a construction of our mind for the purpose of thinking about some aspect of reality. A system is more complex than a single entity; it is understood to comprise a collection of interacting entities that we perceive as forming a whole (Sitte/Winzer 2004).

In general systems theory the word system refers to a part of reality that we wish to analyze. The rest of reality becomes the system's environment. The system and its environment comprise the universe. Our interest and intention will dictate what to include in the system and what not. The purpose of defining a system is to make a complex reality more understandable by dividing it, conceptually, into two parts.

The concept of a system implies the existence of a boundary that separates the system from its environment. Although we are free to define the boundary of the system, only some choices will be helpful in reducing the complexity of the situation while others will not.

Once the extent of a system has been delimited it becomes possible to investigate the interactions with its environment. The system can interact with its environment by exchanging matter, energy and information.

A system that interacts with the environment is called an open system while a system that does not is a closed system. The delimitation of a system allows us to describe an open system at a generic level without knowing any thing about how the internal structure or functioning of the system. This description is purely based on what we observe going into the system (input) and what comes out of the system (output). This description of a system is called a black box model. A black box model ignores all what happens inside of the system.

The first step beyond the black box model it to describe the system as made up of components that interact among themselves and with the environment. By continuing dividing the system into subsystems and the subsystems, and so on, a hierarchical model of the system including levels is created. In a good hierarchical model each level emphasizes some essential

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interaction and hides the less significant details in the levels below. Hierarchical models are very powerful tools for humans for coping with the complexity of the world.

Even dynamic system engineering approaches have been developed.

The thought combining all these different system descriptions and mappings is that we need to think in systems on the one hand, and on the other hand that we need just one step sequence to solve all different kinds of tasks through all disciplines.

General Systems Engineering

The general systems engineering approach includes this system thinking as it is well known and it includes a general procedure model as. The procedure model is split into system design steps on the one side and into a combination of steps on the other side.

Fig. 1 shows the procedure model by having a defined system. The procedure is described by the system design steps and a combination of steps and their instruments.
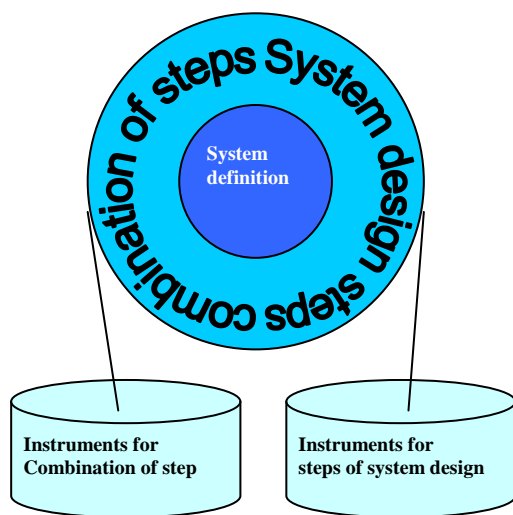
Fig.1: General procedure model concerning the Wuppertal Generic Management Concept

Fig. 2 shows the right side of a circle including the system design steps of a goal building process, an analyzing process and a design process.

The first step to solve a task is to define the system. The second step starts at fig. 2. The tools which are used are depending on the chosen system. This side of the circle is like having three drawers. The drawers can be opened as often and as intensively as needed. But all three steps (drawers) have to be complied. This is the main difference to the approach of Haberfellner. There does not exist a prescribed sequence of use just a demand of use at all.

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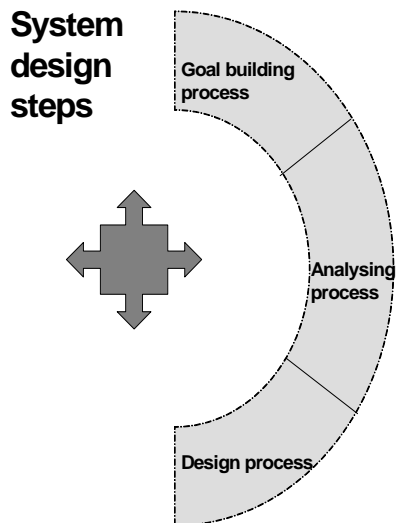
Fig. 2: Part I – System Design Steps
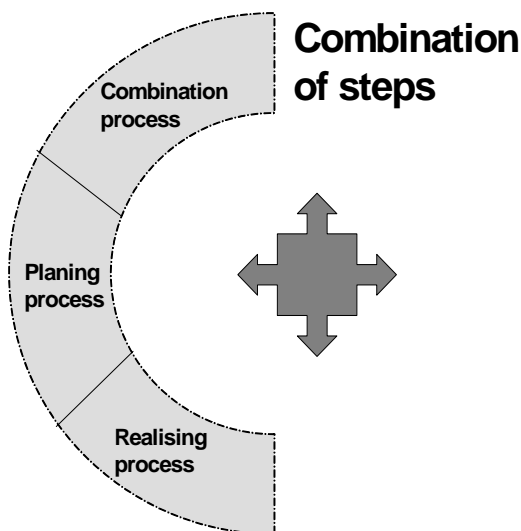
Fig. 3: Part II – Combination of Steps

The right side of the circle is describing <u>what</u> has to be done and the left side of the circle now offers the opportunity to find a way <u>how</u> to do it. The procedure is a dynamic process. The three steps as shown in fig. 2 on the left side have to be followed as well. The way how to observe these drawers is unimportant, it can be process of iteration, it can be a process going from approximation up to detail e.g. Parts or steps of the circle are sometimes stated. If an analysis is preset the following step will be a design process.

A skipping between the two sides of the circle is possible at all stages of the procedure. This designs dynamic process. It creates a general and holistic solution algorithm.

Just two general conditions have to be made:

- systems thinking
- thinking in the described dynamic procedure model

This offers the possibility for interdisciplinary work by using one language, one methodology.

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Application possibilities

The chosen example is out of the field of safety as being described by (Pacaiová 2008, Hoeborn 2008, Winzer 2008). Safety is still one of the latest and quite volatile and politically charged topics nowadays. The field of safety is quite huge sphere and it includes many components concerning the necessities of mankind. The questioning itself includes the complexity of the tasks and the interdisciplinary problems. The purpose of general systems theory is to formulate concepts and methods for analyzing complex situations, processes and structures irrespective of their specific nature. The concepts of general systems theory are very general, at times they appear too general to be useful. At that point it is important to remember that the purpose of these concepts is to provide us with a general skeleton that we need to adapt to the specific situation under analysis. It is like a master plan that lays out the general architecture for a construction. It helps to find the most appropriate overall layout from which we can proceed with confidence to work out the details. When we start a construction we wish to look at our task from a distance so that we can perceive the correct proportion of the elements we have to work with. We want to avoid distorted perspectives and incomplete views that will mislead us to an unsuitable result. We will use the language of systems engineering and our general systems engineering approach to solve the tasks. The special task is to offer a certain amount of safety. Therefore two very different examples are chosen. For both examples safety is a part of quality, fulfilling the requirements of safety means to compliance the requirements and to reach for a high degree of quality. The first example is a large dam offering drinking water on the one hand and offering flood safety on the other hand. The second example is a thermos flask for coffee offering hot coffee. These examples are not directly enterprise related so they can illustrate quite obviously the possibility of transferring the methodology to different tasks.

Figure 2 shows the relation between the system definition, the system design steps and the combination of steps. These dependencies and interdependencies lead to the approach as described in the following text.

Step 1
The first step to solve the task is to define a system.
The system has to be described roughly as shown by fig. 4 through a photo out of space. Very often this system is described by political, hydrological, geographical, geological or morphological, topographical etc. maps. Figure 5 shows the system of a thermos flask. This step one is just defining the system by giving area boundaries. This is the part of systems thinking.

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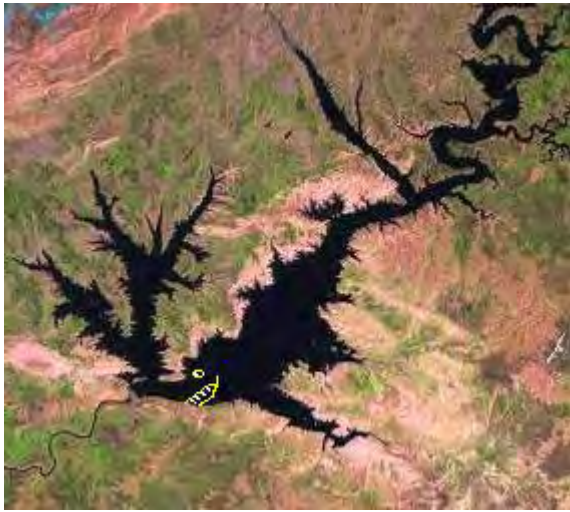
www.luegenjaeger.de

www.corona.de

Figure 4: System Large Dam   Figure 5: System Thermos Flask

Starting with step 2 the procedure model starts.

Step 2

Step 2 is a step out of the right side of the circle the system design steps and it starts with the analyzing process. Concerning the task of safety the analyzing process includes a detailed system definition and description. For this application the safety concerning offering drinking water is in the focus of interest. Fig. 6 shows one part of the system. It is just a part of the hydrological cycle and its interdependencies and dependencies in the system itself and with the environment. This knowledge is indispensable to solve the given task. The next part (see fig. 7) of the system is the amplification of inhabitants, their number, their distribution in the area, their age distributions etc. It is possible to describe the industry concerning kind, distribution and outbound dangers in the same system (Pacaiová 2008). Concerning the second example the thermos flask the safety aspect is to offer hot coffee. The system is partly illustrated in fig. 8.
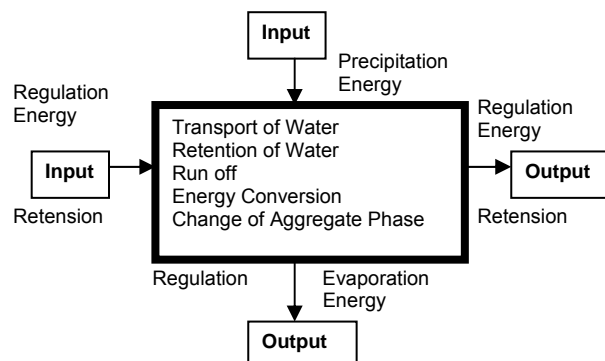
Fig. 6: System Region in the Hydrological Cycle

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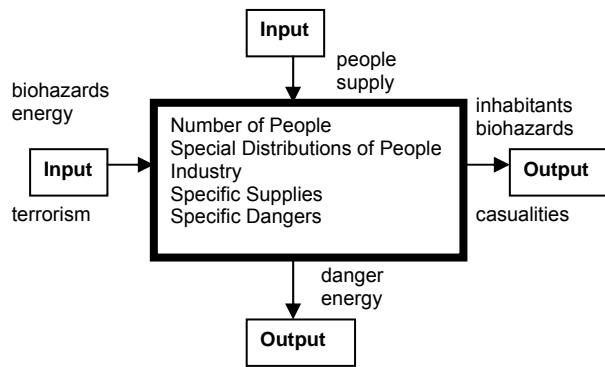
Fig. 7: System Mankind and Industry
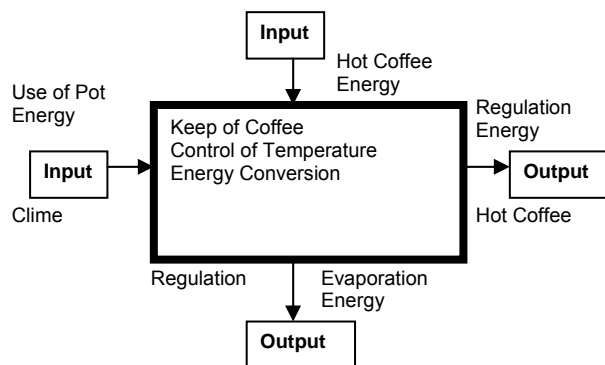
Fig. 8: System Dependencies of Thermos Flask

The specific supplies like fire departments, hospitals or police stations can be defined by the same system as well. It is possible to find as much as necessary subsystems and to describe and define them parallel to each other first. But later on all components have to be combined into one system to get all components. To know the subsystems and their elements is one result but to know about their dependencies and interdependencies is as important (Winzer/ Hoeborn 2008).

These relations have to be gathered and described carefully as well. And of course all dependencies and interdependencies with the environment have to be demonstrated. It was pointed out, that complex problems involve richly interconnected stets of "parts" and relationships between the parts can be more important than the nature of the parts themselves. New properties, "emergent" properties, arise from the way the parts are organized. Even if the parts constituting in a complex situation can be identified and separated out, therefore, this may be of little help because the most significant features, the emergent properties, then get lost.

We find out characteristic features of the system:
   a)   the boundary
   b)   the in- and output
   c)   the components (subsystems)
   d)   the interaction between the elements and the environment
   e)   the interaction between the subsystems
   f)   the hierarchy of the subsystems

Step3

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Step three includes the goal building process. Concerning the task of offering drinking water and to ensure the sustenance with drinking water specific requirements have to be documented.

a) duration of drinking water supply
b) amount of drinking water per person
c) acceptance of distance to get drinking water
d) maximum time without drinking water

The given items are a first idea of important parameters for the goal building process, they may vary.

Concerning the task of getting hot coffee and to ensure the sustenance with hot coffee specific requirements have to be documented as well.

a) duration of hot coffee supply
b) amount of coffee being required
c) acceptance of temperature of coffee

Step 4

The design process is reached. We are still at the right side of the circle discussing <u>what</u> we have to do to solve the tasks. This design process is a first a rather rough idea to ensure the supply with drinking water. A first collection of ideas is:

a) gather groundwater springs
b) gather drilling machine
c) gather pipelines
d) gather containers
e) gather supplying people

Concerning the second example to ensure the supply with hot coffee there can also be done a first collection of ideas:

a) gather a second possibility to keep hot coffee
b) limit the number of person having access to the hot coffee
c) gather a control for the closing of the lid
d) install a temperature control

These given ideas are worked out by different instruments, by different methods. The tool which is used to create ideas is depending on the task. All these steps of the right side of the circle are leading to results which can be seen as a "big cupboard have an enormous number of drawers" and all these drawers are filled with different results in different ways.

Step 5

Doing step 5 means to jump to the left side of the circle, which seems to be like the classical project management. We have to start with a combination and planning set first. This means all the data have to be analyzed strictly and detailed to gather all the necessary information concerning resources.

a) Groundwater springs have given by coordinates. The subsurface has to be described. The productiveness of the spring has to be documented.
b) A drilling machine has to be available. The machine has to be applicable for given subsurface conditions. The drilling machine has to be in the nearby area. The transport duration has to be documented. The duration of drilling itself has to be documented as well. Possible redundancies have to proven and to be documented.
c) The pipelines have to be described concerning diameter, length, connection and the duration of installation.
d) Containers have to be described concerning capacity, number and location.

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e) All necessary numbers of suppliers have to be documented. Detailed tasks and persons in charge of them have to be documented. Their reachability has to be fixed.

Concerning the example of the thermos flaks the results could be as following:

a) The second possibility to keep hot coffee has to be documented (office 3, level 4, room 5).

b) The access to hot coffee has to be controlled. The controlling person has to be available during the requested time. Time, place and responsible person have to be documented. Possible redundancies have to proven and to be documented.

c) The chosen control mechanism like an alarm contact by unclosed lid has to be described. Possible redundancies have to proven and to be documented.

d) The chosen temperature measure method like an alarm contact related thermometer has to be described. Possible redundancies have to proven and to be documented.

Step 6

Step 6 deals with the realization process and it discusses all possibilities of realizing the analyzed data and results.

Step 7

This is mainly a step of controlling but at the time of designing as well. Risk analysis has to be done. The choice of analysis depends on the task. Computer simulation and modelling has to be built up to control the analysis and design process. These results may lead to new start of the procedure module partly or totally.
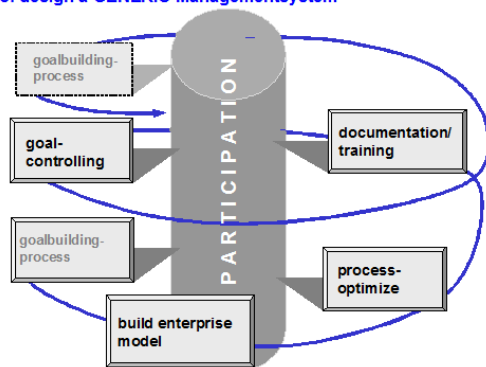
Figure 9: Dynamic Process of Compliance the Requirements

If the risk analysis leads to the result that the groundwater spring is no certain deliverer of the necessary drinking water amount the process has to start again. The detailed system definition and description has to be proven if there could be an additional spring e.g. The procedure may start at different levels and with different tasks again. This process of iteration and of taking requirements dynamically into account is not related to the task.

Conclusions

Different systems, different tasks but all of them are having just one language. We are thinking of and talking about systems. This is the first accordance, the first step, and the second compliance we have is to use the language of the general systems engineering approach. This means that we need just one procedure model to organize the operation. This model is described by the general circle including 6 steps. As the paper has shown this general systems engineering approach is a method of using one language to deal with all systems.

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The big second step is the application of the Wuppertal Generic Management Concept. It is mainly described by the two half circles called 'system design steps' and 'combination of steps'. This concept is based on planning, realization, controlling and advancement; which are the pillars of all management concepts. But additionally the Wuppertal generic management concept is an open, dynamic and requirement oriented system based on a holistic process oriented design concept and it is applicable to all fields.

The model of this ubiquitous management concept is modular. Actually it is based on seven modules [8] and the examples are concerning the module of risk and chance. The examples are quite different to illustrate the ubiquitous application possibilities of the model.

The Wuppertal generic management concept leads to a dynamic and sustainable management concept and it presents a real-time operating system. It is a holistic and ubiquitous concept.

Research Limitations

The theoretical approach of the generic management concept is based on a module structure. These modules have to be defined and described. A lot of research work has already be done, but there are still fields of research to continue. It has to be mentioned that this approach needs more research work to develop a practicable and easy to handle tool.

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A historical perspective on the relationship between firm and the market – on the threshold of a new paradigm?

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Abstract

Purpose
The paper aims to consider the different ways the firm-marketplace relationship has gone through over time in order, on one hand, to develop some interpretive reasoning and, on the other hand, to introduce some questions able to direct future research.

Methodology/Approach
A conceptual approach is taken, trying to provide an understanding of the long-term changings that took place in the firm-marketplace relationship in its first part, and to raise some relevant issues about the evolution to come in is second part.

Findings
In the firm-marketplace relationship evolution five significant stages are to be found: product and selling orientation, marketing orientation, total quality management, one-to-one/relationship marketing, experience economy.
So, if one looks retrospectively and on the whole at the evolution occurred in the above mentioned relationship through the different stages, it's quite easy to realize that a shift took place from:
- mass to individual as supply's addressee
- unsatisfied needs to sensations to be felt as customer's end
- goods and things to services and experiences as transaction's core
in a context of ever growing supply's quantity, variety, quality and accessibility.
From an interpretive point of view, it seems that business firm and capitalistic system got to highest degree of development and of exploitation of their potential, at least if no change of paradigm is assumed.
As a matter of fact, it seems really hard to imagine for almost any product a more plentiful marketplace, a greater choice among alternative offers, a superior technical performance, an easier purchase availability, a higher customization, a stronger perceived utility and satisfaction.
As long as such analysis proves right, it's quite logical to conclude that the ongoing paradigm has reached its possible maximum outcome. If so, it becomes reasonable to hypothesize the rising of a new paradigm in the firm-marketplace relationship, considerably different from the actual one.
(Not) to conclude, some insightful questions for discussion and future research could be:
- how much frequent is a product shortage situation?
- what can be products' quality level?
- is it harder to choose because of too many alternatives or too little ones?
- what can be there beyond a brand able to provide even love?
- how come business ethics and corporate social responsibility are so popular topics of discussion today both among academics and practitioners?
- how come consumption-wellbeing relationship, happiness or, better, happiness paradox are getting more and more attention nowadays?

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- how can simplicity-oriented lifestyle choices and growing number of anti-business movements be explained?
- are there any weak signals of innovative firm behaviour detectable?
- what is the direction such changings are pointing to?

Limitation/implication
As the paper provides a personal interpretation of what happened and is going on from the firm-marketplace perspective, anyone could object or at least non completely agree with such an interpretation.

Originality/Value
The paper tries to take in and to relate to the managerial field some broad issues often discussed in civil, social and economic realm. While firms are deeply involved in the actual state of capitalism and society at large, it seems no equivalent contribution has been made by management scholars in order to find a more suitable role for the firm.

Keywords
Firm-marketplace relationship, evolution, paradigm shift, new firm models.

Paper type
Conceptual paper

1. Notes on the purpose and nature of historical reconstruction

In a world in which the past is increasingly rapidly entirely overtaken by current developments, it may seen that time spent studying the evolution of the markets or other phenomena of previous periods is something of an indulgence. The reality is that it can be a useful exercise and one that is capable of yielding quite unexpected and pertinent results.

The utility lies in the opportunity afforded to take a focused look on past facts and events, filtering out the most essential aspects and discarding less important ones, and in the identification of the source of current phenomena through an understanding of the mechanisms connecting the evolutionary steps.

In short, history allows us to better understand the present which, trite though this truth may seem, has its origins and explanations in the past.

Looking at history also provides us with material to help us forecast future events, not so much through direct extrapolation to the future from past events, but in providing an overview of long term trends.

The future, though yet to be written and subject to many and ever more difficult to predict contingencies, does not emerge ex nihil and has its roots firmly embedded in the past.

The present is none other than a fragile fleeting moment between what has been and what is to come and so on its own can tell us very little about what will happen in the future.

Knowing the past, on the other hand, at least enables us to retrace the ways things have moved over a long period and thus come to a better understanding of the present and the way events are likely to unfold in the future.

For the sake of simplicity, historical reconstruction is usually conducted by identifying a series of successive phases in a process unfolding along a timeline.

It is clear that the separation of a period in the past into phases is an artifice, an expedient that is applied both from the outside and a posteriori. Reality flows seamlessly through time and generally speaking without distinct steps from one phase to another, at least

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excepting periods of true "revolution" where many hugely influential changes are concentrated over a short period.

Despite these exceptions, of themselves not undermining the more general thesis, the usefulness of the process should not be in doubt, helping us as it does to simplify and describe a reality that would otherwise be difficult to decipher.

A second point that needs to be made, perhaps less evident but equally important, relates to the relationship between one phase and the next phase.

We may be inadvertently led to think that a successive phase entirely takes the place of its previous phase, where the logic of the concept of phases gives the sensation of a radical shift in the characteristics of one period to those of another.

The fact is that these evolutions really take place in a layered fashion such that it is accurate to see one stage as being *added* to that preceding it. Certainly it will have different characteristics but within a logic of addition and modification rather than replacement.

Rarely does the phase that follows reduce to *tabula rasa* the characteristics of the previous phase, as with a total revolution. It is far more likely that previous features will have been altered and new ones will have appeared that coexist in a greater or lesser degree of harmony with their those that characterised the preceding phase.

To take the area of personal communication as an example, the telegram did not take the place of the mail service, just as the telephone has not eliminated either the telegraph or the mail. Finally, email has now taken over as carrier of much of the pre-existing communications traffic but has added to the possibilities of communication rather ousting more traditional forms.

Another example, from the world of music this time, it is easy to see that today quite different musical genres coexist, from medieval, to classical, to jazz, soul, blues, rock and others, each with a greater or lesser range of variants of its own. To further complicate the picture there is the problem of how to attach the most appropriate label to any given piece, often no easy task and in any case an approximate science, given the possibility of cross-contamination between genres.

A reading of this kind can also be applied to the fields of ideas, preferences and fashion, with the coining of the word and concept 'meme' a result. A 'meme' is a sort culture gene, a unit of information or communication contract, whether verbal, musical or visual, that can be conveyed from one mind to another through different formats and carriers (Goleman, 2006).

It can be said that in any area or context the present is but the composite and variegated result of a succession of elements and factors whose origins lie in more or less distant historic periods. Each of these carves out its own niche and possesses its own vital charge, though it may not remain unaltered for the whole of its life cycle.

Often importance is unwittingly and erroneously attributed almost exclusively to what is new or at least to that which attention is focused on (the so-called *focusing illusion* (Schkade, Kahneman, 1998) or the tendency to take a one-dimensional view of the world (the so-called *magnetism of monomania* (Balmer, Geyser, 2003)).

Providing that taking a historical perspective in any analysis of the present is not a mere pretext for arousing sterile regret or mere exercise in nostalgia, it can be fundamentally relevant to a proper understanding of current facts, events and situations. Such analysis leads in principle to better reasoned action based on a clear perspective on the present.

In this paper it will first be necessary to seek to reconstruct the story of the relationships between enterprise and the market, and then to suggest an interpretation of the evolution of these relationships, after having introduced some functional questions into the line of reasoning. A final paragraph will apply thought to future scenarios as regards the relationship between enterprise and the market.

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2. A reconstruction of the evolution of the relationship between firm and the market

The relationship between firm and the market, the gradually changing approach towards current and potential customers and company 'orientation', to use a marketing phrase, have all naturally changed over time.

Not altogether surprisingly, there is no unanimity among analysts with regard to the identification of the various phases in the evolution of this enterprise orientation, especially as regards more recent times.

The further back we go we find greater unanimity where the longer perspective makes for a clearer picture. The more distant periods have also been subject to a sort of codification that has been 'handed down' in a generally accepted form, also because there is less reason for fierce debate on what is long gone and where theoretical models that apply are somewhat different from those applicable now.

The phases are often moreover referred to on the basis of a tacit consensus that has been formed in the literature, a sort of accepted truth, rather than by consultation of original source material and the background preceding these phases.

The phases closer to our own time are made up of still living material and have been experienced first hand by many of those called upon to interpret them. The situation is thus a degree more dynamic and subject involvement plays a much greater part, with a resulting lesser level of consensus. Recent periods are therefore more susceptible to varied interpretations.

Another significant characteristic of the evolutionary phase in the relationship between the company and the market is the duration of the phase, with a tendency of the phases themselves to be shorter in more recent times. The closer we get to the present, the greater the proliferation of new approaches to the market. There has, in short, been a speeding up in the emergence of previously unseen types of marketing, leaving aside the thorny question of analysing how truly new these may or may not be.

This situation is not peculiar to this area of life, in the sense that the acceleration in the speed of change has been a typical feature of a great many areas of the modern world in general. Even so, this does very much apply to the world of marketing with which we are dealing here, and it is particularly noticeable in this area, partly because marketing is by its nature at the frontier of change.

This acceleration, in combination with the previously mentioned logic of stratification, leads to a situation, such as we have now, where there is a proliferation of approaches and general marketing fragmentation (Wilkie, Moore, 2003; Cova, Badot & Bucci, 2006).

Bearing in mind the above, it is suggested that the succession of orientations followed by companies has been the following:
- production orientation
- product orientation
- sales orientation
- marketing orientation
- consumer orientation (in the direction of quality)
- relational marketing / one-to-one marketing
- experiential marketing

The selection of the above orientations list, particularly as regards those of more recent times, is necessarily subjective. That it is to say, it is the result of personal evaluations based on a system of weighting and relevance considerations when deciding which from the numerous types of marketing in existence are those which may be deemed most important.

It is quite likely that others may find this list either incomplete or excessively long, while still others may disagree with the order.

Each of the approaches to the market, as well as ideas and competition strategies, seeks to be regarded as truly new, though at times by emphasising differences that are in reality non–existent, that are only apparent or are merely marginal and such more likely than not only cause confusion.

The error induced by the need and desire to present an approach that is different from those that are current (the *self differentiating trap*) is always, in other words, lying in wait. This is also compounded by the increase in the number of approaches that have been given 'the seal of approval' (Balmer, Greyser, 2003).

It is, moreover, objectively easier to carve out one's own area by being the first to use a name or word (Rullani, 2005), in relation to which you have an almost exclusive right to speak, than to subject oneself to honest comparison in a conceptual terrain already populated by others.

Though subjective, the above choice can hardly be described as arbitrary, if only for the reason that the orientations considered are all well-known and enjoy a certain currency both in the academic world and in the business community.

It is not the intention of the author to carry out here a systematic analysis of the approaches in question, but rather to consider only certain functional elements of these, specifically:
- the target of the company's actions
- the customer's aim in the transaction, that is to say what he seeks to get from the purchase
- the company's aim in the transaction, that is to say what it seeks to get from the sale
- the subject matter of the transaction, i.e. what is sold and purchased
- the performance indicator, the main measurable result
- the customer's role, the degree of customer involvement in the relationship with the company
- the key-word, that which best expresses the characteristics of a certain phase
- the symbol-product, that which is most emblematic of a given phase
- the context, the background to the particular phase.

Since the first four of the above orientations are universally familiar (i.e. production, product, sales and marketing), there is no need to describe them here. It is sufficient to refer the reader to some of the best known literature on marketing such as Stanton, Varaldo, 1986; Kotler, Scott, 1993 and Collesei, 2006. Less generally well-known, and more interesting in terms of their greater topicality, is the consideration of subsequent orientations, about which it is worth making a few observations.

In the orientation referred to as *consumer orientation (towards quality)*, the target of the company's action is no longer the mass market, nor even segments of it, but it is the consumer, the client, and the guiding light for the enterprise's decisions and conduct is full customer satisfaction.

The quality of life in the individualistic and narcissistic context of the post-modern world (Siri, 2001; Fuat Firat, Dholakia, Venkatesh, 1995) is the customer's central focus, while the company's aim is to satisfy the customer and hence obtain his loyalty and the resulting financial benefits this brings with it.

Goods and services, used to best meet needs, are the subject matter of the transaction and the *customer satisfaction index* is the performance indicator. The customer plays what can still be regarded as an essentially passive role. There is a shift in that the point of view of evaluating quality is his, but he is still at the end of the process as target of the commercial offer.

The key-words are "I can want", indicating the chance finally given to the customer to ask for virtually anything, "di tutto, di più" (everything, anything) as one large Italian company slogan has it. The opportunity easily then spills over into the putting into practice

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("want"), and within the whole orientation the customer is pictured as demanding, selective and fickle, indeed as a sort of monster (Galgano, 1990).

Japanese cars (Toyota standing for them all) – with their almost impossible to rival price-quality ratio, with guarantees offered that were up to that time almost unthinkable, and as models in a range renewed at previously unseen rates – are the product symbol of this phase, lasting from the second half of the seventies through to the first half of the nineties.

The background context was that of markets that left much room for companies to be able to solve the apparently impossible equation of offering products that really were better at prices that really were more affordable.

The *relational marketing* phase follows, in which the target is the customer, but as far as possible seen as an individual (it is no coincidence that we speak of *segments of one* and micronization of the market) (Gummesson, 1987; Grönroos, 1994; Sheth, Parvatiyar, 1995).

The quality of life is still essentially the aim of transaction as far as the customer is concerned. The quality of life in question is however obtained through ever more customised products, or in any case through ranges that are so extensive as to permit each individual to find a product variant almost *ad hoc* that is coincides with their personal wishes. For the enterprise, the aim of the transaction is to establish a long term relationship with the customer, his *share of the wallet*, and it is on this basis that the performance indicators are measured.

The customer has an active role, he can and must make his knowledge and experience accumulated through his use of the product available to the company itself (Prandelli, von Krogh, 2000). He also makes known his *desiderata,* thus also participating in the planning and design of the product (von Hippel, 1982, 1986). The emphasis in this phase is not, as in the previous phase, to make the product objectively better, but to make it according to the needs and desires of the individual customer.

The verbal expression that would best sum up the situation would therefore be "I can" or "I want to be able", in the sense that at this point the customer has the concrete ability to determine in first person how the product should be made, and such power is naturally something the customer would be reluctant to easily give up.

The product-symbol would be the Swatch watch, where the customisation is in a sense brought forward by the company itself by giving the customer the opportunity to choose from a very large number of alternatives, as well as compounding the choice by bringing out new collections from season to season. In some ways the same can be said of the automobile, where the extension of the range, and the logic of optionals as adopted by all car manufacturers, means everyone can buy a car tailored almost uniquely to their individual profile.

The premise for this situation is the higher level of competition existing between companies, itself due to advancing technology and the opening of markets in the nineties that forced manufacturers to explore all possible ways of acquiring new customers and, still more, keeping their customers by establishing a long term relationship with them.

In the *experiential marketing* the target continues to be the single individual, whose aim is now to seek out sensations, experiences and special meanings (Schmitt, 1999; Pine, Gilmore, 2000). From the point of view of the enterprise, the aim is to home in on the aesthetic, emotional, affective and internal life of the customer by providing goods and services that will generate such sensations, experiences and meaning.

Customer equity is the performance indicator that reflects the company's capacity to establish a long term relationship based on the provision of an experience. Also in this case the customer is active in the relationship, a protagonist for the "scene setting" created by the enterprise, as well as acting as *product designer* as in the previous phases.

The key-word becomes a three-fold utterance as feeling, experiencing and learning. The goods and services are no longer tools for the satisfaction of needs, but rather supports, packages, contexts and situations for the experiencing of pleasurable times and of enjoying memorable sensations or acquiring knowledge or awareness.

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The symbolic product of this phase could be Starbucks' coffee, where the consumption of the high quality and wide-ranging drinks and food offered, is experienced above all as the occasion for spending time in a pleasant atmosphere, feeling part of a world with which the customer wishes to be identified, and also becoming (at least in his or her imagination) in some way an expert in the 'art of coffee'.

The premise, or at least the principal condition, that from the end of the nineties to the present has defined the new ethos is partly the near saturation of material needs satisfaction, i.e. sophisticated needs as well as basic needs. There has been, on the other hand, the emergence of a need for people as consumers to find something more, something more profound, something with further layers of meaning.

3. A new look at the relationship between the enterprise and the market

If a retrospective and all-embracing gaze is directed at the evolution of the content and manner of the relationship between enterprise and market, it can be seen that certain changes have occurred:

FROM	TO
- mass	- individual as interlocutor with the company and recipient of the offer
- needs to be satisfied	- sensations to be experienced as the final aim of the transaction for the customer
- goods and objects	- emotion and meaning as the subject matter of the transaction
- passiveness	- pro-active role of customer
- needs and wants	- feeling-experiencing-becoming as key-words.

all of which unfolding in a scenario of increased quantities, varieties, quality and novelty in what enterprise offers in the respective markets.

To illustrate this shift from the mass approach to a dialogue between the company and the individual and to the single consumer as target, we need look no further than the terminology adopted, e.g. market, segment, consumer-client and finally person. The term market refers to a generalised, non-differentiated, uniform and impersonal entity; segment refers to a part thereof, a portion of the market with specific characteristics; consumer-client reflects a focus on a still smaller entity, possible the individual, though seen reductively as user of goods and finally 'person', unequivocally referring to the individual as complete subjective entity with its own qualitative profile. The 'arrival' at the individual person is entirely in line with a more general post modern ethos in the west, according to which the wellbeing of the individual is the start the end and the measure of any subjective behaviour. Certainly the change in the definition or terminology used does not actually mean that the companies today entertain personal relations with each of its customers, even though in some cases the trend is indeed in this direction, thanks largely to new technologies that make this ever more feasible. Nevertheless, even the simple change in the terminology employed is itself indicative of a change in attitude, if for no other reason than the undoubted power that words have to actually construct reality.

As regards the ultimate aim of the purchase, it can be said that originally there were true needs to be satisfied. There was a widespread lack of goods and things to meet the various needs of existence, both due to actual scarcity of supply and to the inaccessibility of part of the demand. The same consumers later set about seeking to improve their quality of life, delegating to others less enjoyable tasks and directly procuring 'wellbeing' by engaging in enjoyable activities. This phase was finally followed by that of the pursuance of fulfilling

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wants and desires (Fabris, 2003), not to mention whims and caprice (Bauman, 2002), as well in some cases simply seeking out new thrills and sensations. Having gone beyond having to satisfy simple needs, while leaving aside the old chestnut of what constitutes a 'need', the doors open to a situation in which each has the right or even a perceived duty to pursue happiness as best he thinks fit – and there is no doubt that buying things is one of the easiest, effective and genuinely most gratifying ways of doing so. To possess something does not require great or excessive individual effort; it is not like learning to play a musical instrument, it is easy to compare oneself with others in terms of the levels or type of purchases (who hopefully have less), and the pleasure of making something one's own and to make the use of it you will is almost unequalled (Belk, 1988).

Alongside the goods and services, there has been a steadily development of emotions, values and meaning as the subject matter of the transactions themselves. It is still true that the subject matter of the sale today is, and what people continue to wish to pay for, are goods and services, but these are above all vehicles, tools and occasions for obtaining sensations, for broadcasting ideas and for re-establishing meaning. Certain types of products have always played a role that goes well beyond their function, the motor car and articles of clothing are obvious examples. The significance lies in what they communicate about us or even the extent to which they help build the identity of the owner or wearer. The point is that this tendency has intensified as regards the types of products concerned, being extended to other areas that were previously excluded from such value attribution. Goods have thus been enriched by the addition of new experiences (for example many car manufacturers now offer their customers specialist driving courses or trials on race tracks), while services have accentuated their communication content (where for example tourist destinations are offered according to an "interpretive" approach which furnishes the client with meaning to be drawn from visiting the location). What were personal occupations and experiences have been "packaged" and sold "off the peg" (for example children's parties are sold that have been planned in minute detail by catering companies that provide the location, the food, the entertainment and the gadgets and so on and so forth).

Taking the product communication choices as a starting point, and moving through the planning for the reasons that lead to its acquisition, we end up with a situation in which the nature of the goods themselves have been subtly changed. Take certain food products, for example, such as the ready-to-eat soups "That's Amore" from Findus and "Make love with the taste" by Müller, or household electrical goods such as the Margherita washing machine from Indesit, sold with the message "We Work, You Play". Such products are sometimes experienced not so much for what they are, i.e. food or a machine for washing clothes, but as a way of taking care of oneself or as a form of self-gratification. Given that our reality is largely a construct of communication, the product name, image and the words associated with in the advertisements, together with the associations generally associated or subliminally created, result in a product that has passed from being something that is solid, tangible and massive, to being something that is as emotional, intangible and ethereal as the spirit of the time. The material and physical object is transformed into the subjective, incorporeal status of perception.

As regards the role of the customer, this was entirely irrelevant and beyond management's horizon when the company's task was to establish a production process, both for quantity and for quality. It was only later that the consumer became the object (albeit passive) of investigation, analysis and awareness on the part of the enterprise, with the explosion of market research methods. More recently the customer has assumed an ever more significant and pro-active role in relation to the company, exchanging product testing information, and now taking part in what is referred to as *collaborative innovation* (Prandelli, Verona, 2006). In this type of co-operative venture, the mediation of the digital infrastructure makes it ever easier to ever more effectively incorporate the knowledge and the desires of the consumer into the company's processes and, moreover, to engender exchange between the

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final users themselves as regards information, knowledge and preferences in relation to this or that product.

Looking at the key words, the series of words identified with the various phases – need satisfaction – having - wanting (being able to want) – being able to (wanting to be able) – feeling, experiencing, becoming – unequivocally point to the psychological condition of the purchaser. Where the starting point can be described as that of objective weakness, the customer goes on to become a significant force and authority in the relationship with the enterprise, obtains the objective of attaining pleasure in every day life and chores and finally satisfies his or her existential aspirations.

Such an interpretation of the historical process enables us to appreciate the extent of the changes that have taken place, and above all over a short time, with regard to the relationship between the company and the market. In each of the examples considered above, it can be seen that truly momentous, if not total change has taken place. A person with no historical memory, aware only of the present, would be quite unable to imagine how and to what extent the target offer, the aims of the purchaser and the subject matter of the transaction, and so on, were different from what they are today.

4. Exercises in reflection

To help us begin to move towards some conclusions it would be helpful to reflect on a number of questions.

The aim of the questions is to focus on certain market situation background factors that might at first sight appear obvious but which are for that very reason easy to pass over without consideration. These factors are in reality most relevant, especially in relation to this type of macro analysis.

These are items deriving from diachronic observations on aspects relating to the quantity, variety, quality and newness of what is offered to the market.

Since these background elements tend to stand out little and to escape careful attention, it would serve the observer well to change perspective and focus from time to time so see what may be before our eyes but fail normally to be objects of perception.

Historical analysis once again in this sense proves to be a useful instrument, revealing certain basic details of the relationship between enterprise and the market that really should not be overlooked.

Far from being rhetorical or simply irritating questions, they aim to elicit an honest response from the reader, requiring also a view point that is different from what otherwise may have been taken. Only by comparing opinions with those of others is real progress likely to be made in our understanding.

The questions are useful in evaluating the accuracy of, or at least the extent of any consensus regarding, any interpretation of the proposed enterprise-market orientations, and are the issues on which the conclusions in the final paragraph essentially hinge.

If the responses elicited are not consistent with those of the author then there will be a need to review the interpretation put forward in relation to the evolution in question and, if necessary, consider abandoning or adjusting the line of thought that has been followed.

If on the other hand the responses coincide wholly or in part with those of the author then a certain consensus will be in the process of formation around that idea that the current phase is close to its conclusion and that a new evolutionary leap is inevitable, both in theoretical and in practical terms, towards a new relationship between enterprise and the market.

The question should include the following:
- How often is there product scarcity?
- Is it harder to choose because there are too many or too few alternatives?

- What would the general evaluation be of the quality level of the products?
- How do the products on offer measure up to the requirement of newness?
- What is more able to kindle a passion than a brand?

How often is there product scarcity?

Anyone living in an economically developed country, leaving aside any periods of recession and their seriousness or otherwise, finds that the number of products available for the satisfaction of material needs, desires and even whims and caprice is indeed very high. This is also increasingly true for anyone living in the often highly populated and ever more numerous developing or recently industrialised countries.

Whether we are talking about commodities, tangible goods, services or experiences, in each case the simple fact is that supply is abundant.

Apart from those particular products whose great success has resulted in the formation of waiting lists, the lack of products is certainly not a problem today. Indeed, mass production technologies and more recently information technology introduced in the manufacturing sectors have made possible increases in the volume of production to virtually any desired levels. Any problems are more likely to be in the area of distribution and availability in the time and places required.

Just consider how difficult it is to think of any examples of time when a product was simply unavailable.

Is it harder to choose because there are too many or too few alternatives?

The alternatives for the consumer to choose from, as regards brand, type, form, colour, size, functions, characteristics, accessories, price and all other possible relevant from case to case are extremely numerous at this time.

If any product is taken as an example, whether it be a car, a television, a garment of clothing or just a ball-point pen, and the number of variants on the market is considered, it would hardly be an exaggeration to say that such a number is astonishing.

There is no doubt, therefore, that the problem is not one of quantities, or of finding a variant that meets the need, quite the contrary.

If anything, the problem today is the breadth of choice available to consumers. Despite the fact that greater choice is always seen as a good thing, when it goes beyond a certain point it may take away the pleasure of shopping because of the psychological effort required of the purchaser and the fear of making a less than ideal choice (Schwartz, 2005).

What would the general evaluation be of the quality level of the products?

The quality levels of products taken can be regarded as undoubtedly high in terms of the real and/or symbolic capacity to respond to the various needs, as well as in terms of technical and manufacturing precision, ease of use and duration.

While it is certainly not easy to give an absolute evaluation, it is equally true that what really matters is comparative assessment, and it is undoubtedly the case that products are generally qualitatively better than those of similar sectors from the past, leaving aside those wholly new products for which there is no such historical yardstick.

The considerable impetus provided by *Total Quality Management* and the connected spread of the *kaizen* principle (continuous improvement) have had an effect in terms of market entry for a whole generation of products. Without examining specific product areas here, it is clear that frequently the perceived value against price ratio is extremely high.

Though the steady introduction of digital technology in the production of many products means that it often has more sense to replace a broken down product than have it repaired, it remains true that products are now more reliable and longer lasting than in the

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past. There has also been great progress in the area of convenience of use of products though innovations to the products themselves or to their packaging.

Take, once again, almost any area of goods and try to think of situations where products have not been improved as regards their technical performance, reliability and ease of use. Of course, quality is determined by price and it is clear that really inexpensive products cannot offer the same level of quality as their more costly alternatives. The point is however that in general what manufacturers and service industries offer has reached quite noteworthy quality levels.

Apart from such possible exceptions as the field of air transport where flight cancellations, overbooking and lost luggage are perhaps more widespread and frequent than in the past, the failings of goods and services in terms of fitness for purpose and duration are rare, with the purchaser's needs more often than not being fully satisfied.

The requisites of *must be quality* as they are referred to today, are minimum requirements that are given as read by the customer, but it should not be forgotten that they in reality reflect production standards that are in fact very high, incomparably higher than those expected only a relatively short time ago.

Paradoxical as it may seem, the main problem today is if anything the excess of features and the long life of a great many of the products. This excess risks the loss of the pleasure of the purchase due in some cases to having to replace goods that have not yet reached the end of their lives.

How do the products on offer measure up to the requirement of newness?
Not only is supply abundant, with extremely wide-ranging variety and quality levels capable of satisfying the highest expectations, but it is also characterised by being highly up to speed with latest developments and quite new in nature. Also in this case the *Total Quality Management* approach has had notable effects, with the speed of introduction of new models, renewal of ranges and the modernity of products all at the highest levels.

In some cases, or for certain categories of consumers, this may simply be excessive in the sense that there is often a widespread perception that the new product is already 'old', with the conviction that a competitor or the company itself will shortly be launching a new version on the market.

This is typically true of IT products and consumer electronics, but may also be felt in such less rapidly changing areas as that of motor manufacturing, which is rapidly aligning itself with this trend. Another emblematic area is that of clothing, where the speed of introduction of completely new lines may reduce the life cycle to a matter of weeks, incidentally a factor at the heart of the success of some of today's best known fashion brands.

Irrespective of the unease this may cause some consumers to feel, what interests us here is how supply is today clearly capable of fully satisfying the demand for new products.

What can more ably kindle love or passion than a brand?
It is authoritatively argued that the best companies are able to kindle real passion in their customers who love their brand and their products. The company sets out to establish a relationship based not only on performance and respect but even based on something akin to love (Roberts, 2004, 2007).

Many examples are frequently cited and even though maintaining this positioning at the higher levels of the respect-love matrix may be difficult over time, there are always new companies that succeed in becoming a *lovemark* in the hearts and minds of their customers.

There is no doubt that when the company works on its competitive strategy, it often seeks to construct a brand that will cause its customers to lose their heads and give their loyalty to the company on a basis that that is not rational but emotional, while such a winning process may not be immediately realised.

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On a wider front, going beyond the legitimate objectives of the individual enterprise, the question takes on a different valence. From a broader perspective the problem becomes, where do we go from here? What is the next step after the limit has been reached of satisfying what is important for the person and gives meaning to the individual's existence?

From the moment that companies no longer offer simply instruments (goods) or utility and solutions (services), but seek though a brand or label to establish themselves as the embodiment of a personality that the customer can relate to emotionally, it would seem that we have reached an apparent end point from which it becomes difficult to progress further. What further competitive edge can be obtained, once human feeling, occupying by definition a central place in the experience of what it is to be human, is the target?

5. On the threshold of a new paradigm?

Based on the above historical reconstruction and interpretation, the effect of the stratification of company orientations has made unparalleled quantity, variety, quality and product renewal available to consumers compared with the past. It would however also seem that such progress would be very difficult to continue further. The individual consumer, on the other hand, ever seeking full satisfaction of his or her needs, emotions and sensations has become a pro-active target of the companies and the ultimate protagonist at the heart of the market.

From the point of view of the individual sector and/or the individual enterprise, there are still forward steps that can be taken, improvements that can be made in this or that area. It may nevertheless be argued that, all things considered, within the current paradigm the market economy has got very close to complete exploitation and it would be a very complicated matter to go any further along this road.

Taking a general overview, it would seem impossible to improve current forms and means of responding to needs, to desires and even to whims and caprice, or even the needs for customisation, perceived value, fine tuning of needs, abundance, technical and manufacturing perfection and the provision of choice.

Once the consumer orientation, relational and experiential marketing phases have achieved their aims, it is hard to envisage the next step while remaining within the current paradigm. All possibilities would seem to have been exhausted or at least to be in the process of being exhausted.

Proceeding on an incremental basis, there would seem nowhere to go in terms of further quantity, variety or novelty, in the effort to significantly increase either market demand or levels of consumer satisfaction.

Despite great efforts and in the areas both of theory and of practice, the search for new competitive strategies and notable creativity in terms of new forms of marketing, the fact remains that the scheme is embedded in an unchanged framework.

Leaving aside certain particular businesses that have been guided by unconventional principles, the general relationship between the enterprise and the market is still characterised by opposing factions, conquest and the search for ever more sophisticated ways of winning the customer's preference.

Such routes no longer seem capable of yielding the desired results, given that the consumers now have access to supply whose overall characteristics are already sufficient for requirements, not to say over in excess as regards the satisfaction of virtually any nuance of any possible need.

The usefulness of historical reconstruction emerges in its ability to reveal in overall terms the factors along the path that have given rise to the succession of individual steps that, when considered one at a time, fail to reveal to the observer either the total distance covered or the direction of movement.

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The point of view posited here decidedly highlights only certain particular facets of the relationship between enterprise and the market, bringing with it the risk of producing a starkly drawn picture of reality, and one that could be excessively pessimistic. It is not therefore the intention here to disavow the fact that it is always possible to find specific situations in which there is room for effective action and for necessary improvement.

Without claiming the absoluteness of this truth, the fact is that there is increasingly restricted room to manoeuvre in this area. It may however be that the level of competition in the markets in general will lead to high-risk strategies from some entrepreneurs, also where ethical standards may not be universally high, as they try literally anything to ensure the survival of and hopefully further growth for their companies

In short, the current paradigm is close to the end of its life cycle in the author's view, with this phase having achieved what it can achieve and ripe to be usurped by another phase which will necessarily be quite different. In other words, the evolution of the relation between firm and the market is likely to encounter discontinuity in its path.

Predicting such discontinuities, the so-called "black swans", is ex hypothesi impossible (Nassim, 2008). Great changes are inevitably accompanied by fear and apprehension, making it all the more difficult to be lucid when trying to understand what could be about to happen.

On careful examination, there are however some weak signs of theoretical approaches and also of some practical action, that may help to open the lock to the future.

On the theory side, there are now numerous international articles by respected authors reviewing the role of the company and the way it interacts with the market. There is no space here to analyse, even briefly, this very interesting and significant area. A much-reduced list of articles of interest can however be given here, limited as it is to some of the most recent of these, in an area where criticism of the capitalist system goes back a long way.

This list of colourfully-named recent titles is primarily meant to stimulate the reader's curiosity. *Good business. Economic success and ethical conduct* (Csikszentmihaly, 2007), *Saving capitalism from capitalists* (Rajan, Zingales, 2004), *The Fortune at the Bottom of the Pyramid: Eradicating Poverty Through Profit*s (Prahalad, 2007), *The support economy: why corporations are failing individuals and the next episode of capitalism* (Zuboff, Maxmin, 2002), *Brief tractatus on serene degrowth* (Latouche, 2008). In the field of marketing in partiuclar, orientations have come into being such as *Quality-of-Life Marketing* (Lee, Sirgy, 2004) and *Consumer Well-Being Marketing* (Sirgy, Lee, 2008). Most recently a situation has even been reached in which any reference to the market is abandoned, with the coining of the new term *societing* (Cova, Badot & Bucci, 2006; Fabris, 2008).

In company consulting too, an area by its nature closer the operational sphere, a somewhat negative perspective can be discerned as regards market approaches lacking wider sensibility. The two important organisations of the Aspen Institute and McKinsey, for example, have in recent times repeatedly publicly stressed the need for the company to widen the demands to be taken into consideration in its decision-making processes.

There is no question that it is more difficult to adequately test the ground as regards the demand side. The steadily increasing intensity of competitive comparison, together with frequent shareholder pressure to rapidly achieve ever better financial returns, seems to hold sway over the implementation of innovative orientations as regards market behaviour formulations and the production and organisation of companies.

That said, there are individual examples of "virtuous" companies that in some way escape the prevailing unfettered pursuit of the production of wealth. Such examples may be highly significant in providing practical demonstrations of the application of a possible alternative *modus operandi.* Apart from the particular cases, that it could be argued are not substantially represented in the market, there is the more structured experience of companies that coming within the so-called Economy of Communion, based on giving. In this model, economic activity is not an end in itself but is part of a process of supporting humanity and

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society. Entrepreneurs who join this process, while remaining within the market economy, are particularly conscious of the human ramifications of their actions. They are willing to give a third of their returns to help people in difficulties, a third towards promoting the "culture of giving" that is specific to that approach, and a third to the development of the company itself.

There is, on the demand side, a surprising sentiment manifest in the economically most developed countries. This has taken a couple of different forms, which have as might be expected have resulted in the use of the term "paradox", due to many observers' difficulties in comprehending the phenomenon according to "normal" reasoning. The first is the paradox of happiness, or the negative correlation between wealth and individual happiness (Easterlin, 1974). The second is the progress paradox, i.e. where even though human living conditions are infinitely better than those of previous times, people feel worse (Easterbrook, 2004).

There has, secondly, been a rise in the spread of attitudes, conduct and movements which, with varying degrees of intensity and involving varying degrees of collective engagement, would scale down the weight of the economy and of goods both in the life of the individual and in that of society as a whole. These movements are those associated with 'slow living' and 'voluntary simplicity' or the adhere to the 'less is more' slogan of groups who make their primary needs purchases together (Social Buying Groups), rather than to those groups that variously oppose interference in the economic sphere, such as Commercial Alert, New American Dream, Institute for Local Self Reliance and rather also than to ideologically motivated groups such as the so-called No Global groups as variously manifested politically and geographically.

Irrespective of the degree of activism and public impact in terms of consumer behaviour, there is a growing awareness, or at very least an unuttered feeling that consumption of itself is not enough to bring happiness or wellbeing (Scitovsky, 2007). Indeed, the somewhat bitter realisation that wealth and consumption are not enough is beginning to sweep over increasing strata of the population, and perhaps even that they might be more of a hindrance than a help in the fulfilment of their aspirations.

These weak signs of stirrings are perhaps allow us to glimpse a dissatisfaction that presages change. The number and the intensity of the signals picked up in relation both to supply and to demand, as well as the cogency of arguments put forward in the literature, suggest that we are on the brink of a decisive renewal of the relationship between enterprise and the market.

The point is, however, that neither the academic theory nor pilot experience seem thus far to have actually changed the way of thinking or working of the majority of companies. Those business following a different logic are few and very much the exception, and are not entirely unreasonably viewed as being mere 'one-off' blips.

It is moreover impossible to say to what extent the current 'system' is able to resist the forces of change. The effects of the process of inclusion of very large areas of the world in the market economy system are even less easy to predict. The result is that it is an extremely difficult task to forecast what form the next phase in this evolution will take.

Apart from the question of the extent to which the weak signs referred to above will actually produce real transformation, it is the aim of the author here to suggest that the need for change in the relationship between enterprise and the market should not just be a matter of external pressure on the business world and on entrepreneurs, (Baccarani, Giaretta, 2000), but also an internal, natural process aiming at the survival of the business itself and at positive developments in the company's relationship with the market.

In the wake of an understandable demand for profound reforms in the field of marketing (Sheth, Sisodia, 2005) and the plea for a commitment to and focus on real problems rather than looking for "precise answers to wrong, well-defined, narrow problems" (Raju, 2005), the aim of this paper has been to illustrate the impossibility, or at least growing difficulty, of continuing with the relationship that has been pursued up to now. The strong suggestion is that companies should start to independently support new ways of organising

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the relationship between production and consumption before such changes is forced upon them by circumstances outside their control.

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Improvement of planning quality by the early use
of "Quality Design" in the product development process

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Abstract

Purpose – "Failure-prevention Teams" and "Kaizen-Teams" are used after the "Start of production" in order to improve deficits in quality and to reduce costs and production times in the automotive industry. This paper shows the connection between "classical failures removal" and "waste avoidance" and why this should be done already during the product development process.

Methodology/approach – The abstract definition "failure" is extended. Building on that a combined application of the methods "3P" (Production Preparation Process) and "Failure Mode and Effect Analysis" (FMEA) is developed and verified. Besides, an approach to measure the benefits of combining the 3P and FMEA method is given.

Findings – The results imply that 3P and FMEA are complementary approaches and once they are combined, their capabilities to avoid failures are enhanced. The capability and maturity level of the organisation determines the success of using this method.

Originality/value – This paper redefines the abstract definition "failure". It shows that a great optimisation potential is available in the product development process and how it could made useful.

Keywords – automotive industry, product development process, Kaizen, 3P, FMEA

Paper Type – Research Paper

1   Introduction

The challenge of a turbulent market is drawn by globalisation trends, altered preferences on the buyer's market and a reduced product development process time (Weißgerber, 2001). Furthermore the saturation of traditional markets and an ascending diversification of products lead to a fierce competition. The customer demands high quality requirements to the product and the service involved. Apart from this the customer demands a quick delivery with an adequate price. Because of the ascending diversifications the customer is not bound to a special manufacturer and moving to a new manufacturer is simplified. In consideration of quality, price and availability the customers will make their purchase decision. The competitive capability of the manufacturer is based on productivity and quality. Only those manufacturers, who are capable to serve the *triad of success* which is quality, deliverance and costs for the customer, will overcome the challenge (Womack/Jones, 1996).

Especially European and American automotive manufacturers are struggling with problems as poor quality, high manufacturing costs and time schedules (Harbour, 2007), although an increase of productivity (Figure 1) can be stated (Rauber, 2007).

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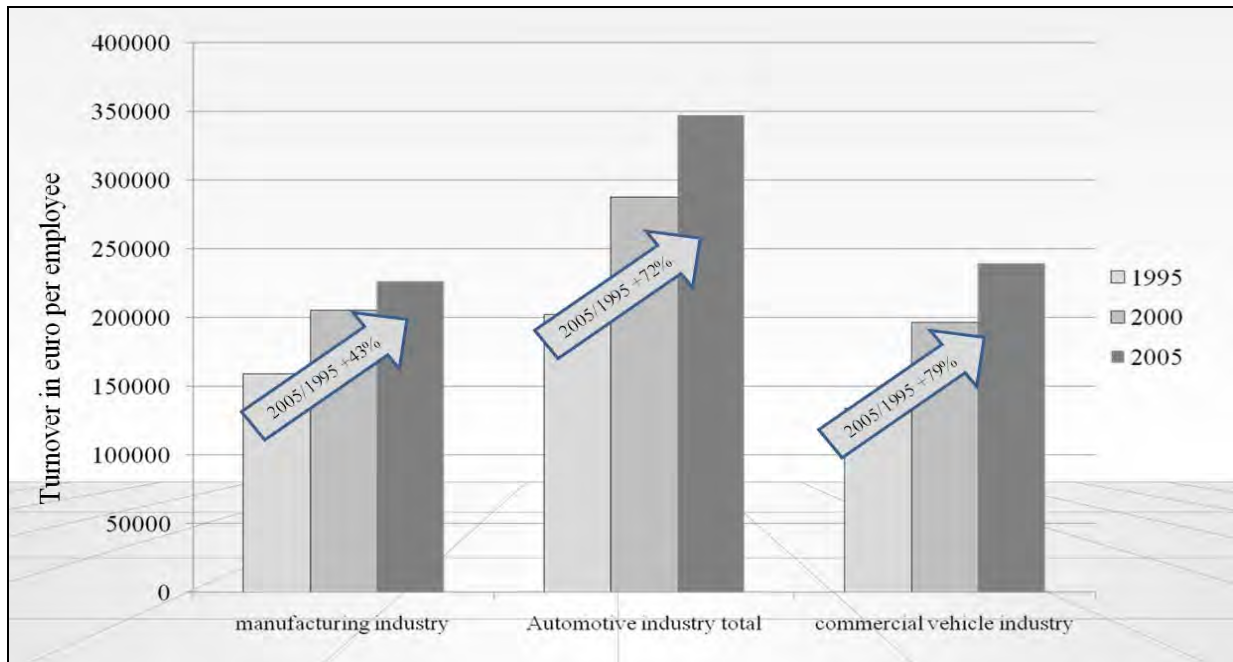
Figure 1: *Productivity – Turnover in euro per employee (Germany) (Rauber 2007)*

The production time of the European and American automotive manufacturers is much higer than the production time of the Japanese competitors - although the "Hours per vehicle" (HPV) are continuously decreasing. Besides production time, quality deficits and subsequently the low degree of customer satisfaction increase the economic pressure on the European manufacturers. Studies of the market research institute J.D. Power and Associates suggests hat the Japanese Manufacturers Toyota, Honda, Mazda and Subaru are leading the customer satisfaction statistics (JD-Power, 2006).
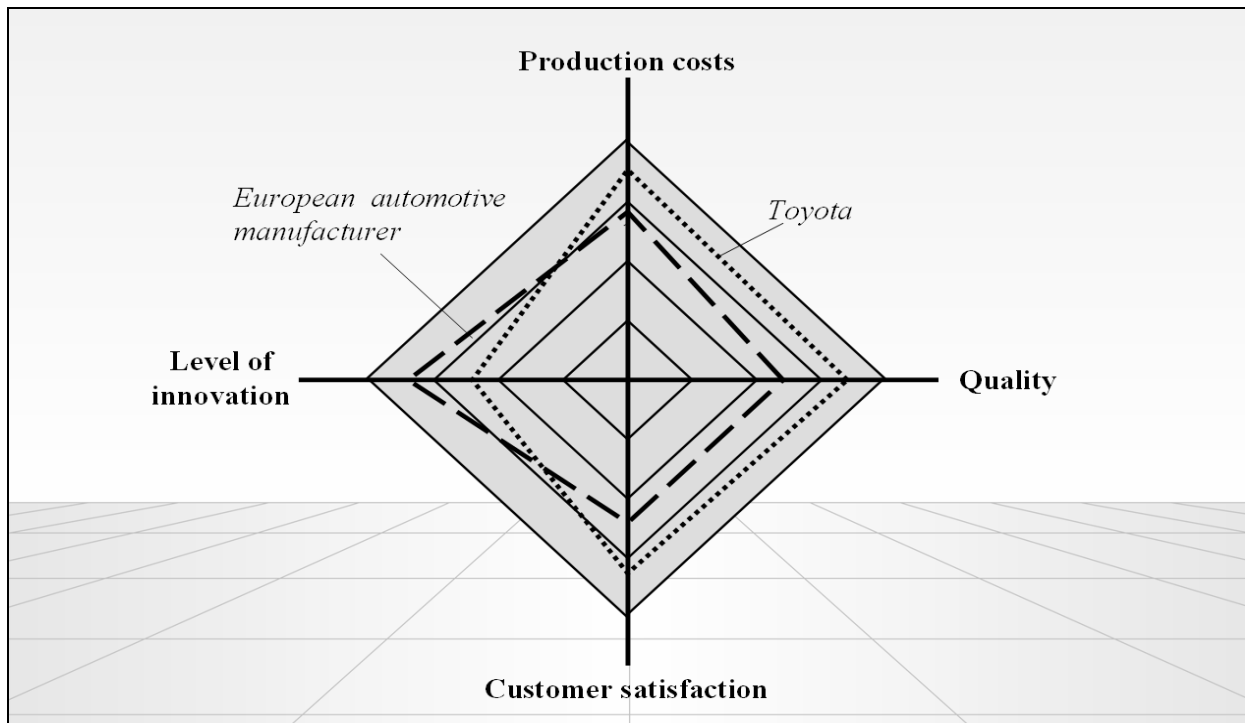
Figure 2: *Challenge of Manufacturers*

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Besides the high manufacturing cost, deficits in quality entail enormous follow-up costs which could sum up to 5% of the annual turnover of the manufacturers. In simple terms the expenditure for warranty expenses and accommodation costs is as high as the expenditures in the Product Development Process. Moreover the effective date and volume of occurrence is not predictable (Dörr/Feldmann, 2006). The actual costs caused by negative effects on customer satisfaction and dwindling brand loyalty are incalculable. Provided that only 5% of the unsatisfied customer will complain, 95% of the customers drift away silently (Albright/Roth, 1992). In addition to that they could damage the reputation of the manufacturer based on negative mouth-to-mouth propaganda due to the fact that they keep prospective buyers from purchasing (Biallo, 1993). In order to keep their competitive ability against the "Japanese Competitors" European and American automotive manufacturers have to cut down their costs and increase their quality simultaneously. The Japanese automotive manufacturer Toyota is not only highly profitable (152 billion € turnover, 9.9 billion € asset) but also the highest sales volume manufacturer (Götz/Rumpelt, 2006). For that it could be seen as benchmark. In order to lower the expenditure for warranty expenses and accommodation costs, and to renew the customer satisfaction, European and American automotive manufacturer try to reduce the quality deficits in product and process by using a reactive and resources intense "quality offensive" (Jones, 2006). It seems that these quality offensives are considered as "random-button-pushing". Supply difficulties are solved by additional shifts, poor quality by additional surveys and rework (Sharma/Moody, 2001). It becomes clearly recognisable that merely the symptoms during the production process after the Start of Production (SOP) are improved but not the ultimate/real cause. This leads to the conclusion that product and process quality and therefore the productivity could only be improved by changing the symptoms and connected failures.
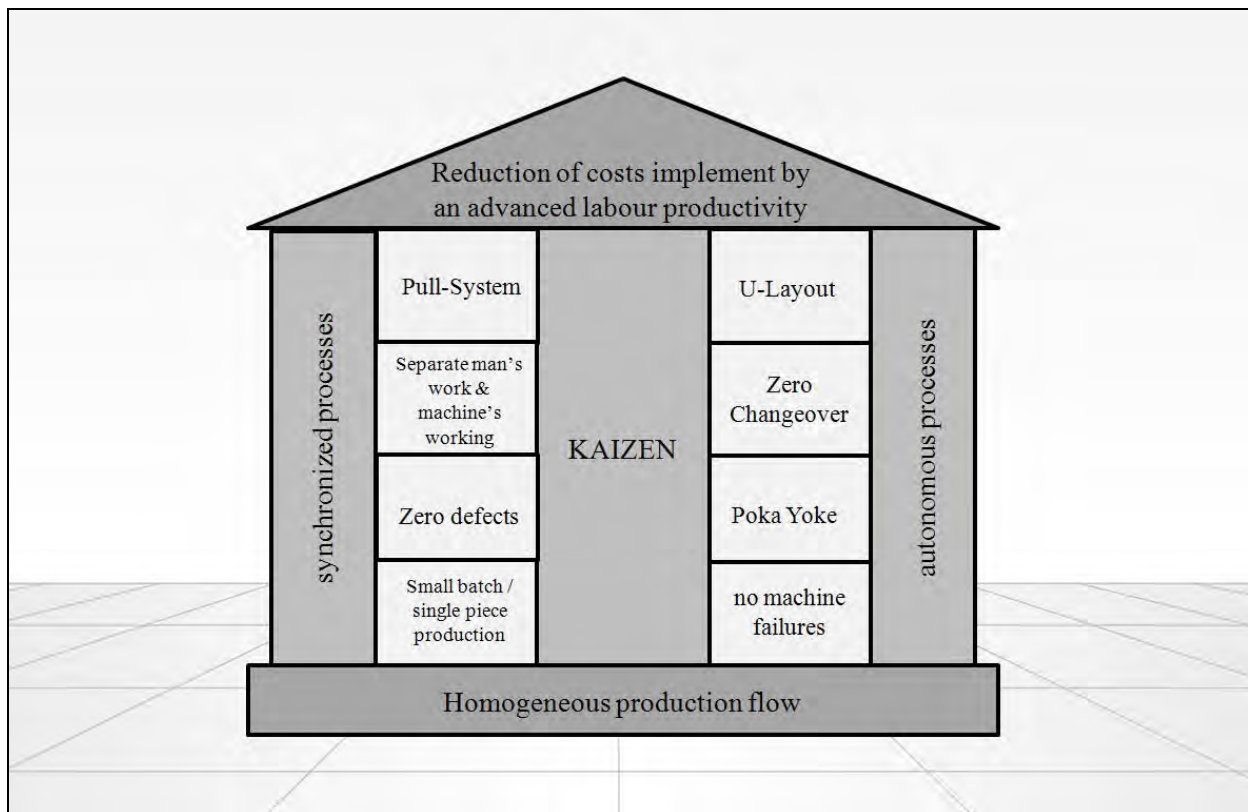
The product development process and an innovative quality management

First of all the challenge of an innovative quality management is to ensure or increase the economical performance. Essential profit maximisation is possible in two different approaches. The off-site approach is characterised by a high consumer satisfaction. In contrast to the off-site approach the in-house approach is directed at a decrease of costs. In order to improve the productivity the product and production process have to be optimised. As a consequence of these approaches the quality level has to be increased sustainable (Bruhn/Georgi, 1999).

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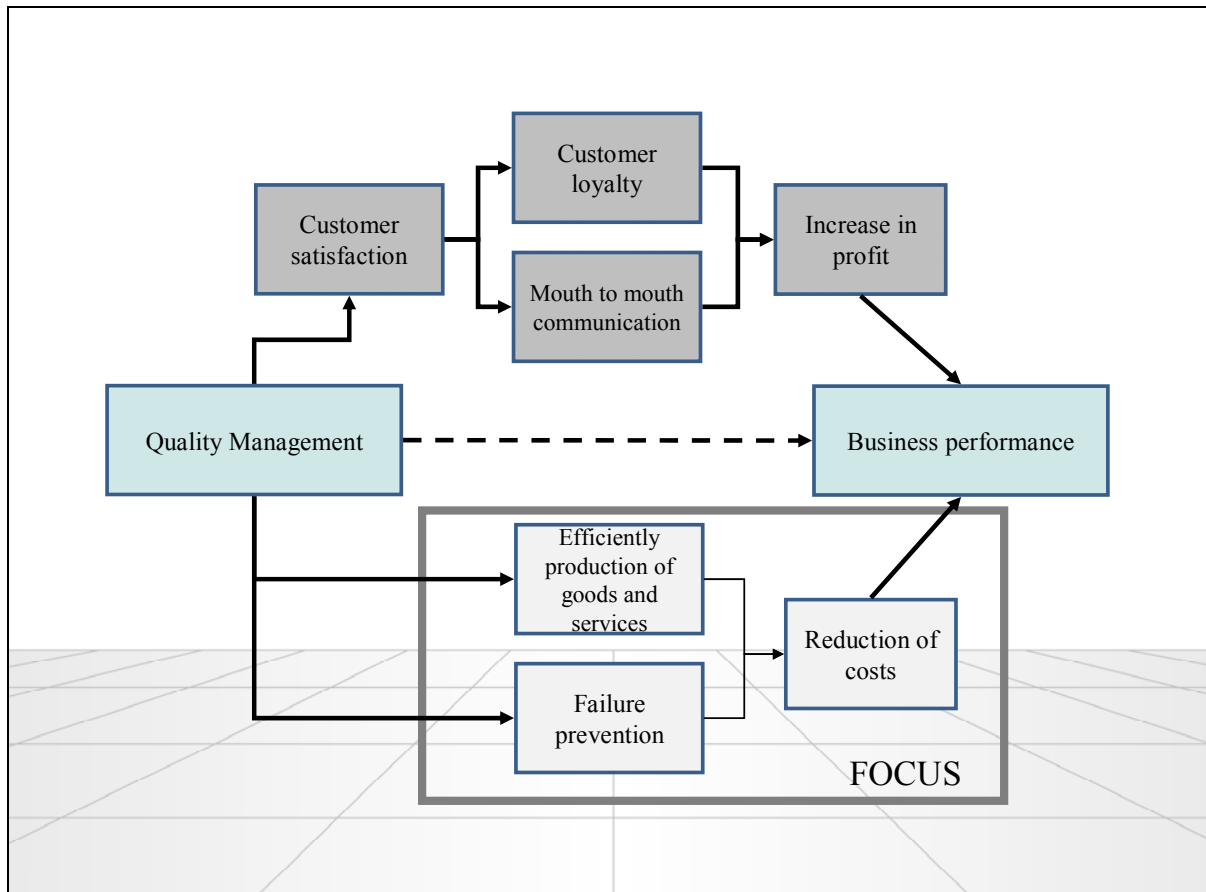
Figure 3: *QM off-site and in house (Bruhn/Georgi, 1999)*

The formula of success of the global automotive market leader (Toyota) depends on a homogenous production flow which is based on high quality level. In addition to that the advance labour productivity contributes to lower production costs continuously. Based on the Toyota Production System (TPS) (figure 4) cost-cutting are implement by an advanced labour productivity associated with a high customer satisfaction. The goal of the TPS is specified as maximum quality, lowest production costs and shortest through-put time. This correlates with the triad of success.

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Figure 4: *Toyota Production System (Ohno, T., 1991)*

Currently the European and American automotive manufactures adopt well grounded the main principles of the TPS under the designation "lean production" because of the MIT Study "the machine that changed the world", which verifies the advantage of the TPS in contrast to the "western" production plans (Womack/Jones, 1991).

The basis for the following serial mass production is set during the product-development-process (PDP). In this time frame the "product development and –verification" as well as the "Planning and verification of the production process" are projected (Figure 5). The productivity is influenced by the product as well as the intended production process. For this reason the first level of influence is located at the PDP. The aim of this approach is to increase the process reliability in the following serial mass production characterised by the aspects of cycle time reduction, ergonomics, safety and quality.

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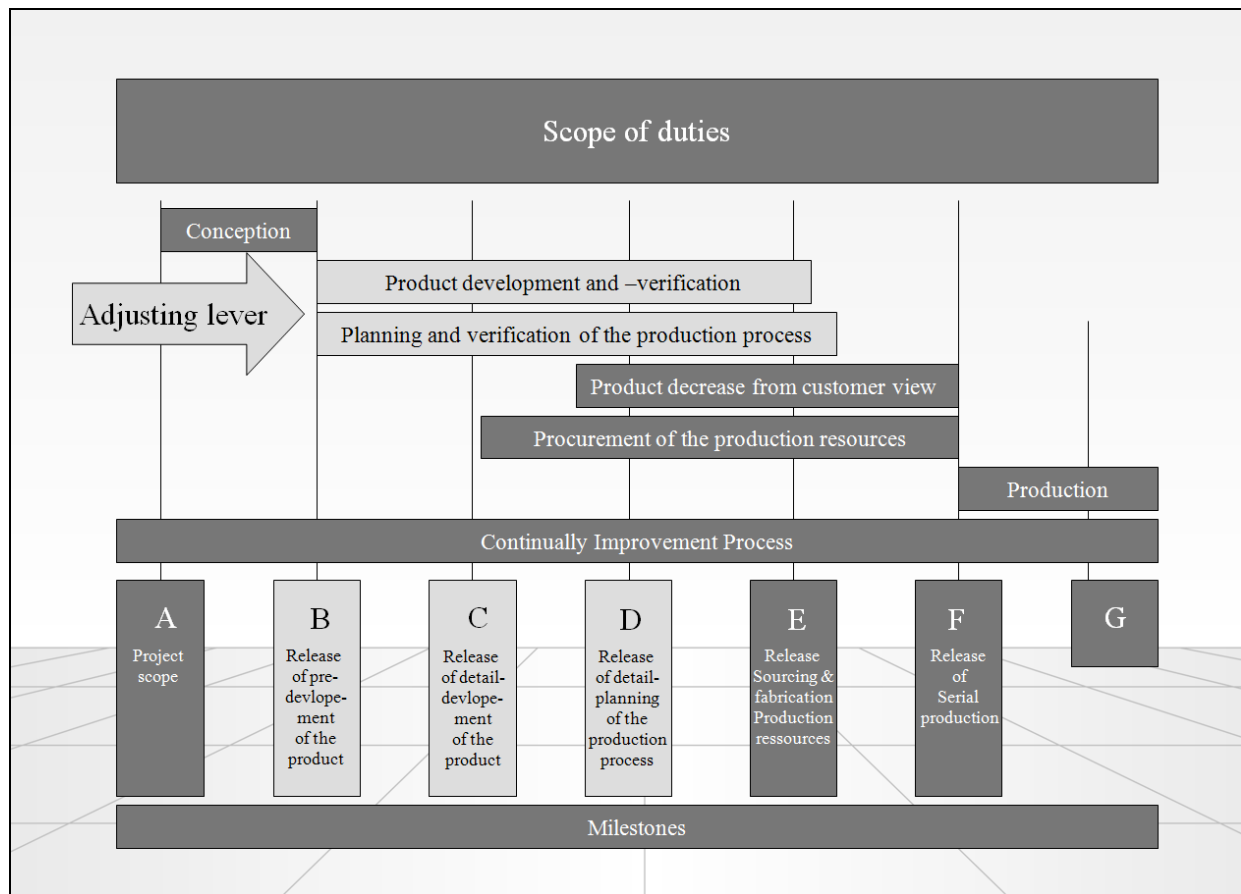
Figure 5: *VDA-PDP* (VDA, 1998)

Essentially four of five levers are available during the PDP to increase productivity on the "product-side". The first lever is called the "engineered hours per vehicle" (EHPV) or construction-conditioned production time. In this case it describes the initial situation that the worker is in range of the vehicle equipped with the needed tool (for example impact screwdriver) and the device which should be assembled.

The second lever is called "Failure prevention". The device should be designed accordingly so that potential failures (for example wrong sheeting) could be excluded.

Moreover the third lever is called "Time spreading" and describes the time-based delimitation between the sheeting of a maximum and a minimum model. It goes without saying that a huge "Time spreading" could easily lead to a fitment which is only possible above several cycle.

Furthermore the fourth lever "Standardisation" refers to a minimal number of variant-parts. This could be achieved by standardisation of components (for example a modular upgrade of a generic building block) or standardisation of single devices (for example bolts screws etc). The goal of standardisation is the large scale use of equal devices.

Finally the last lever is called "First pass yield". It may be defined as the quote of finished vehicles without ex post treatment. On one hand the "First pass yield" must be used with some reservations because of the small influence during the PDP on the other hand it has a great significance for the later production process. Additional levers to increase the productivity "process-sided" are investment costs, human-resource allocation as well as the required floor space which are influenced during "Planning and verification of the production process" (figure 6).

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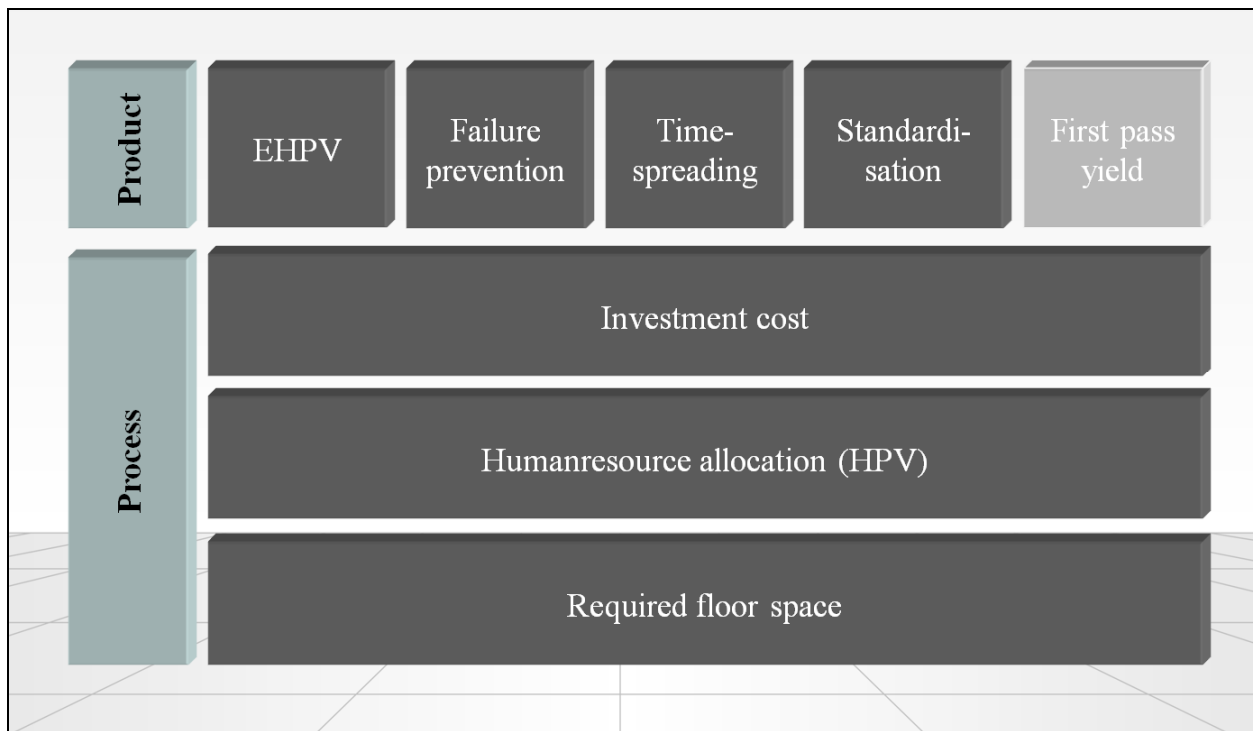
Figure 6: *levers productivity*

Productivity is the quotient of output to the use of resources. In order to increase productivity available resources must be better utilised. Levers could be found in the product as well as the process. First of all the resources must be used optimal and free of waste. On this account the abstract definition "failure" must be extended. A failure is not only the non-compliance of an operation or standard but also a non efficient performance (waste) with regard to the product preparation.

In summary, nine issues of waste can be stated (Liker, 2004):

1. Overproduction: This includes every unit which is produced without sales order result in a non interest-bearing accumulation of capital.

2. Idle time: Essentially a result of starving or blocking because of machine bottle necks, die change etc.)

3. Dispensable transport: Basically multiple transport of raw material without processing

4. Inventory: In essence, stock of materials and buffers between individual process steps since these buffers are often not emptied "first in first out" old material remains frequently and could only be disposed later.
5. Movement: Basically long and non value-adding movement
6. Reoperation: Deficient devices must be reworked costly or are directly scraped. The disprofit is increasing the later the failure is detected during the value added chain
7. Insufficient communication: Imprecise information which causes requests and if the worst case comes to worst, leads to failures and reoperation.
8. Unergonomic operation technique: Essentially "Zwangshaltungen" (stoop working position) but also inaccessibility especially during assembly
9. Needless processes: Basically unpacking or repacking of materials, idle running but also "retorque", die change and conforming of work content as well

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Regarding to the nine issues of waste, only 10 % of an employee work is direct value adding for the customers (Sekine, 1995).
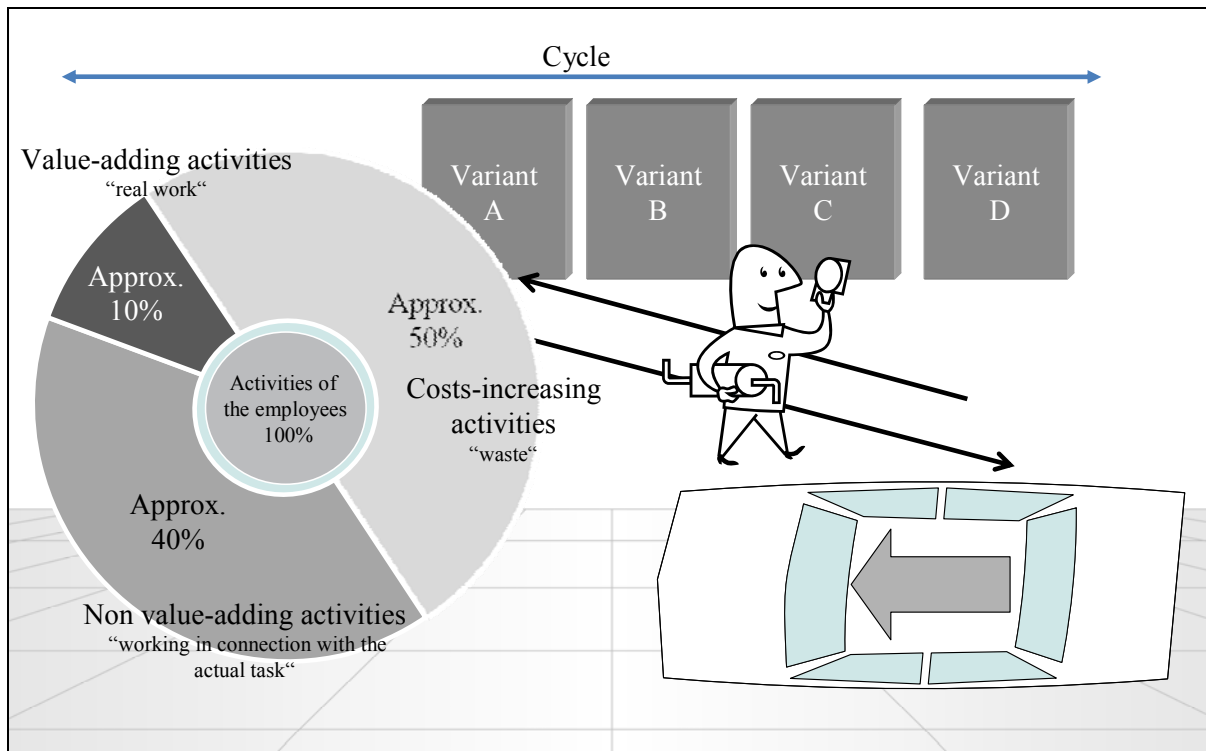
Figure 7: *Value-adding activities on the basis of Sekine*

This provides an interesting example for the different point of "problem viewing" between the European automotive manufacturer and Toyota. This is considered to be an important factor in appliance the Lean-thought. Toyota identifies correctly that the non value-adding time of the employee must be reduced in order to increase productivity. Lean means free of waste. The European and American automotive manufacturer on the other hand increase their productivity by slimming down the numbers of employees.

"Lean is not mean" (Daniel T. Jones)

The assignment of an innovative Quality Management is to avoid failures (including waste) and accordingly the poor quality which originates from the developing and planning of new products and processes.

2 Reason for waste – unilateral focussing on product innovation as well as the general planning process

Principally it is not possible to split the planning in "normal activities" and failure prevention activities. One does simply not develop something and add on a certain amount of quality (Masing, 1993). In simple terms the grade of quality, which is considered in the Product developing and Product planning, is strongly influenced by problem perception of the Product developer and Product planner. Essentially the problem perception of the Japanese automotive manufacturers - especially Toyota - is focused onto standardisation of processes, to products, to operating equipment, to infrastructure and to organisation according to the TPS. These standards are improved continuously. "Innovation jumps" as in the European automotive industry simply do not occur. Product developers and planners do their business through the guidelines of the TPS. Because of that they know which problems need attention. (Liker, 2006).

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So the reason for waste lays in the unilateral focussing on product innovation, which could be particular observed by the European automotive manufacturers. New products with more and more technological innovations and conjunction to shorter lifecycles put highest requirements to the development and the associate planning. It is not surprisingly that the planning on its part transfers the increasing technological demands (product) by the use of more and more technical innovations in the production process (new manufacturing-process, new equipment etc.). The problem perception indicates that the technology must be increasingly more precise in order to meet the demands of the product innovation. In this context employees are frequently seen as pure expense factor which has to be minimised. The preventive verification of the product and processes is done by the use of different quality methods (for example FMEA, etc)

On grounds of the superior Japanese automotive manufacturers, European and American automotive manufacturers adopt several parts according to the TPS:

- KAIZEN
- TPM
- JIT
- One Piece Flow and
- Pull-Systems etc

are only some examples. Nevertheless the parts of the TPS are converting inconsequently in the Product development and Product planning because of the unilateral focussing on innovation during the PDP. It can be easily demonstrated by the example Pull-System. Although the Pull-System (one piece flow) is accepted to be trend set, it is not adapted consistently by the European and American automotive manufacturers. Still inappropriately big buffers and safety stocks are planned. Not surprisingly that this is caused by suboptimal production processes. As a result a „Fake-Flow"(Figure 8) is created which suggests a Pull-System although it contains waste in form of inventory and therefore "hidden failures" (Sharma/Moody, 2001).

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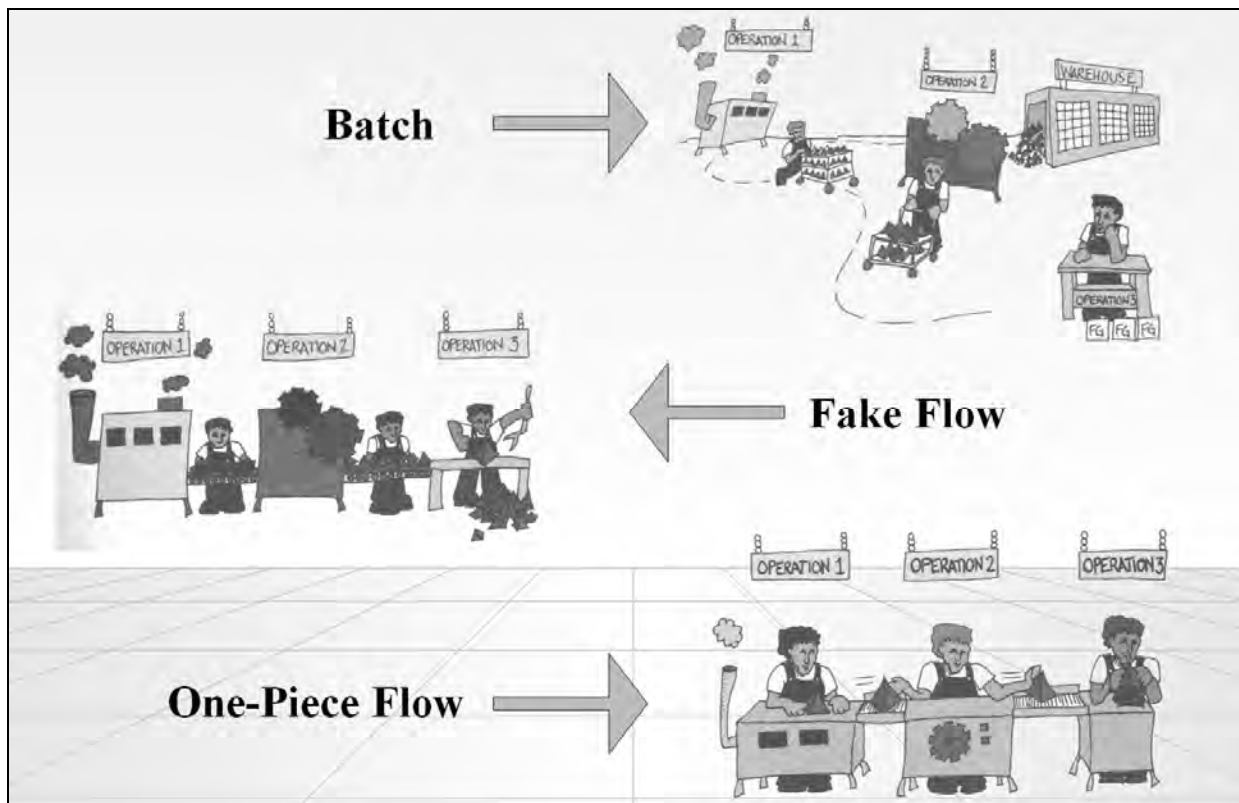
Figure 8: *Fake Flow*

Considering the whole, it must be determined that failures in the classical sense are prevented by the use of quality methods (for example failure mode effects analyse - FMEA) but failures in form of waste are not consequently cut off during the planning process.

Several reasons could be observed. On one hand new product innovations lead to special specifications which have to be adhered bindingly. The waste which is designed into a component (variants, different torques, screw types, working position etc.) is frequently not confessed in the development. On the other hand the planner is not aware of the different types of waste, because they did not appear in his problem perception. Accumulating for many years, several paradigms have been cultivated and are regarded as fix (requirement of large stocks in order to prevent downtime and loss of production if a previous process is broken down). Machines that show a large number of features are purchased although a lot of features are not needed to the performance of the task ("over engineering"). In addition to that too little practical relevance is put in the process planning. In this context it is interesting to note that this is intensified by the tools of the Digital Factory since they suggest that ideal processes can be generated by "plug & plan". This is made clear by assistant solutions that are supposed to help the workers (for example manipulators) but for various reasons (for example time duration, complicated handling) are not used by them. The most beautiful plan does not use anything if the person responsible does not stick to that! The Digital Factory could not ascertainable the reality in a ration of one to one. It does not provide any feeling for movements, weights etc. This raises special problems, processes which seems to be easy digitally emerge as non process-secure in reality.

In order to change the problem perception, the participants in the product development process must be supported. A key function is attributed to the planner for that reason, since he is the connecting link between development and production. To sum up, the planner must bear in mind the requirements of the development but also the production needs. The plan must be tested preventively on failures.

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3 CIP at the Product development process

Production lines are optimised by continuous improvements (CIP) after the Start of production. This is necessary and important in order to increase the productivity of the local existing production lines. But it also demonstrates which great potential was left behind in the development process. At this stage the method 3P (Production Preparation Process) is brought to application. First of all the set goals of the 3P-Workshops are maximum quality at consistent prevention of waste (optimal workload of the employee etc). Moreover a minimisation of used resources in regard to production time, technology (investment) production area as well as logistics expenditure as a goal. Naturally the reduction depends on the preliminary planning status.

Fundamentally the ambition of the 3P-Workshops is characterised to gain perfection during the production process. In order to reach these, the product and planning state is checked for so called method building blocks, similar to the TPS. Essentially the avoidance of waste, but also the simple failure recognition (visualisation) is set as goals in the production process.

Basically the use of teamwork creates a large number of various ideas how the production process can be optimised according to the prerequisite of the KAIZEN-Method:

- Increase the value of the product continuously during the process
- One piece flow
- Pull Systems
- Use ideas, no money (reuse of available things)
- "Trystorming" (instead of discussion try out at a 1:1 model)
- Quality, Quantity, Timing (do not think of costs)
- Sacrifice „holy cows" (creative thinking – out of the box)
- Low cost automation instead of high tech solution (only features which are absolutely needed)
- Employee stands in the centre of interests (ergonomics)
- Elaborated measures must be transformed

The group of participants, a "crossfunctional team" consists of planning, industrial engineering, development, logistics, quality assurance, workers as well as the management which has to bear the results of the workshop.

As a rule 3P could be described as a searching for simplification. Every team member has his own viewpoints onto the different problems. Especially colleagues from a different subject/profession have their own domain knowledge and do not have any thinking-boundaries (paradigms) and are therefore important "new idea senders". This does not mean that the developer product-sided and the planner process-sided have planned poorly. The result of their good work is strongly influenced through existing paradigms.
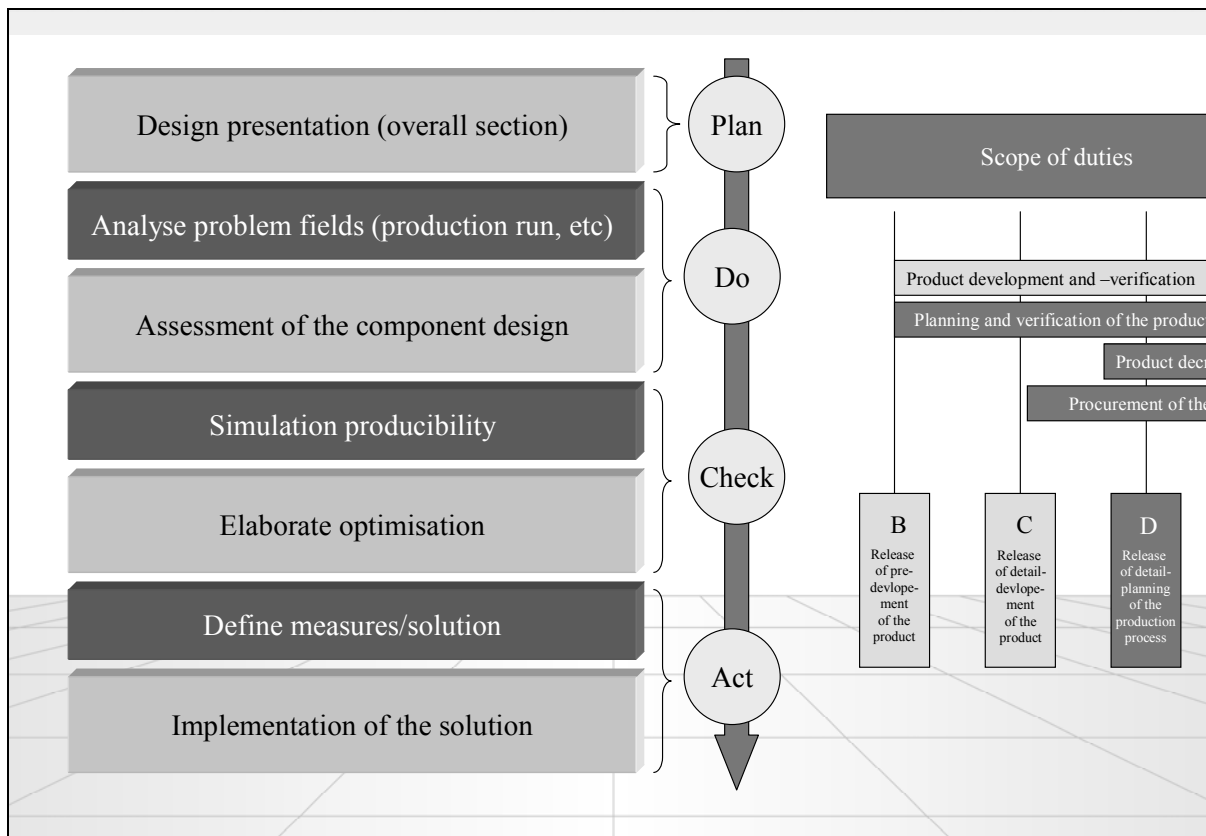
The course of the 3P-Workshop occurs in three steps. First of all the so called Virtual Product-/Process conversation serves as an upbeat. It contents affirmation of the general reducibility by the use of Digital Mock Up (DMU). This is necessary against the backdrop. If the product is not producible in theory it must be changed. Following to this Virtual Product-/Process conversation the 3P-Workshops takes place.
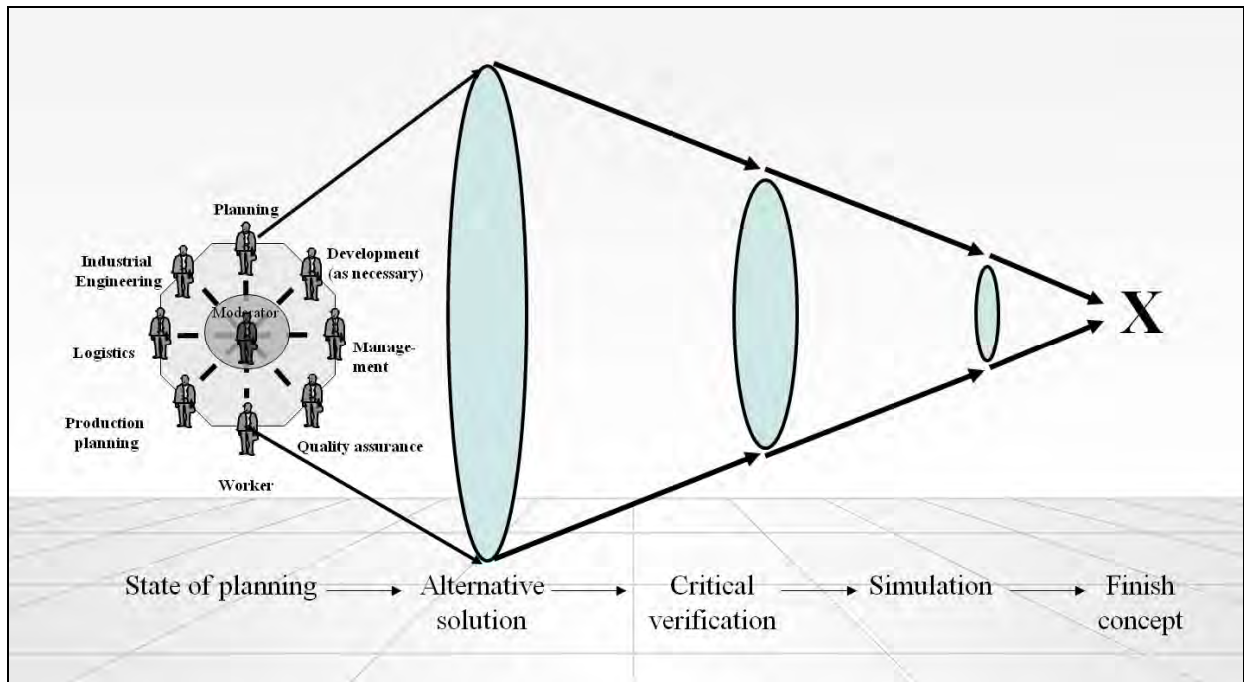
Figure 9: *Participants and their focal points*

3P-Productworkshop

During the 3P-Product workshop the existent development status is analysed through potentials for savings (EHPV, standardisation, etc). The Design states are examined with regard to feasibility, tolerances and variants (Time spreading). In this case the focus is set onto the premises of the planning meaning the adjustment of product concept and the design of the process and operating equipment. The goal is to minimise the EHPV for the device (Figure 10).

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Figure 10: *3P-Product workshop*

Subsequent to the 3P-Product workshop the 3P-Process workshops occur.

3P-Process workshop

Adapted from the basic concepts of the value adding and synchronic production the focus of the 3P- Process workshop concentrates on the inspection and optimisation of the planning based design. Therefore the manufacturing process, the production equipment, the appliance, fixtures and the configuration and the layout of the production line are defined. Moreover the logistic conception and cycle time is defined (Figure 11).

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Figure 11: *3P-Process workshop*
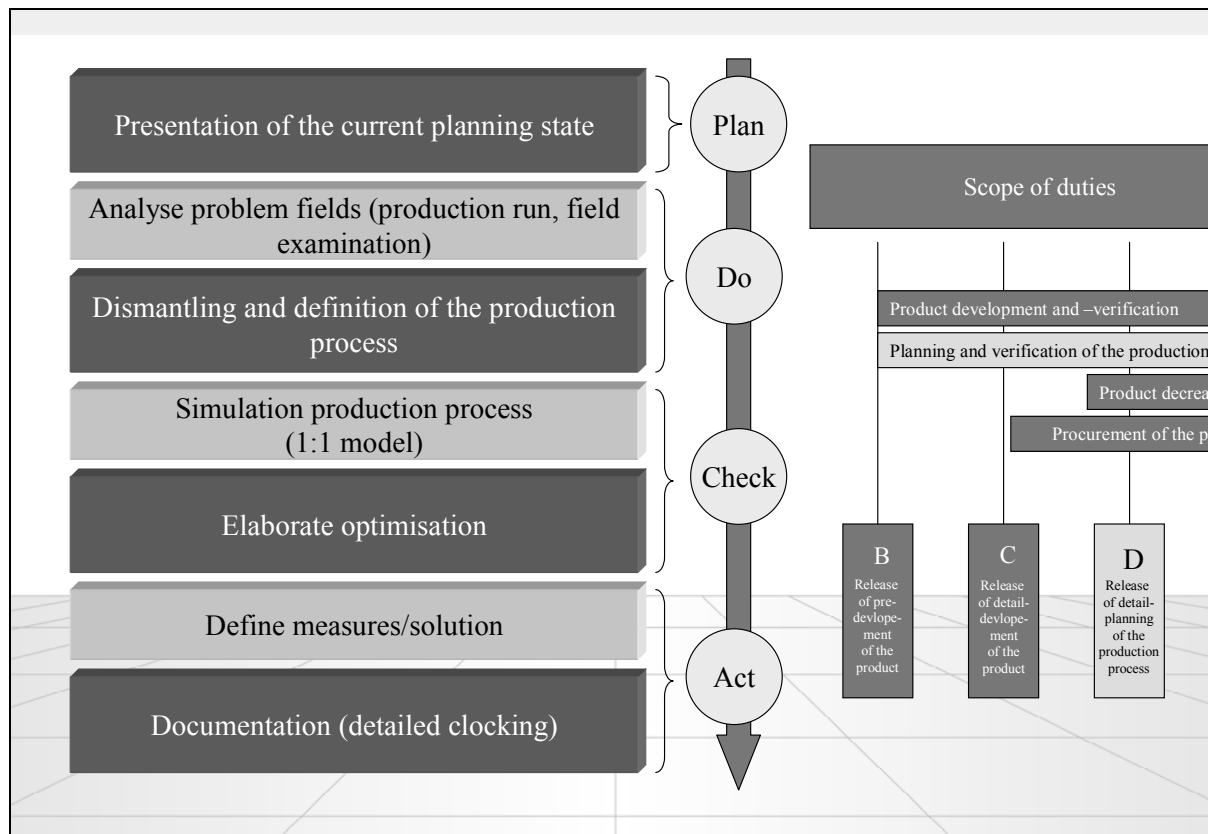
For that reason several "main method components" must be considered:

- 9 types of waste
- "Eintakter" (signifies that within one cycle the complete work content is sheeted)
- Ergonomics (optimal labour conditions for the worker)
- One touch one motion (install components the way they are caught in one motion by the worker)
- Poka Yoke
- Container designs (no large standard stillage)
- Cycle time & value adding (minimise "Time spreading", focus on value adding)

Essentially the method components are used for breaking existing paradigms open and to give new/fresh impetus to the planning. In conclusion, it should be pointed out that the HPV is decreasing and therefore the internal costs can be lowered. The condition precedent is an optimisation of the EHPV and the reduction of the production time. However it is very difficult to define the saving potentials in form of a hard figure, because the quality of the preliminary planning status can vary. In general the difference between investments, production area and HPV could be compared.

External costs, especially in form of a case of damage occur in addition to the internal costs. In this context the question is how these external costs could be lowered (Figure 12). Roughly speaking these costs are most simply made as "an amount X that is set to every car" in order to pay cases of damage in the field (warranty and guarantee).

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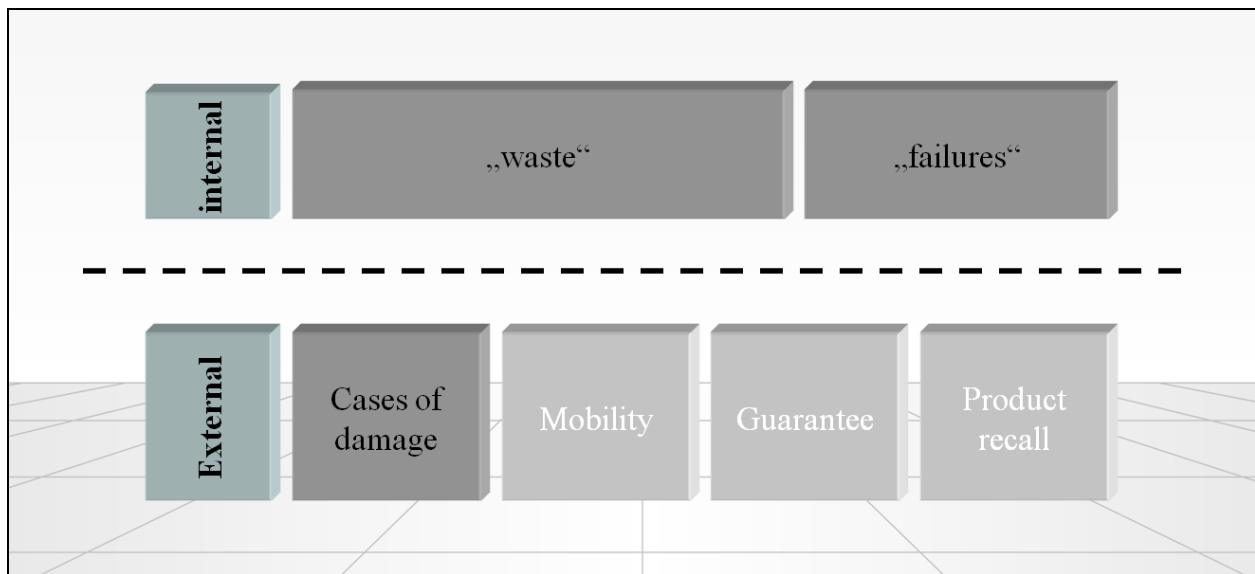
Figure 12: *internal and external costs*

4 External costs – waste through defect cases

Until now only the internal waste was considered. As pointed out in the introduction, the costs for pay cases of damage (SF) in the field are near up to 5% of the turnover. Annualised, a sum of approx. 3.0 – 9.6 billion € is spent by the western automotive manufacturers.

The classical error avoidance and failure prevention is requisite in order to minimise these costs. The quality method FMEA is proved to be effective if it is used correctly. Since a lot of external failures have their origin on internal failures, a connection between these two cost drivers must be established.

3P-Workshops are helping to reduce failures before SOP (internal failures in form of waste). But the costs for pay causes of damages in the field evolve after the SOP. That is why the pay cases of damage must be estimated and respectively predicted. For this purpose experience of the predecessor models, actual analyses of available defect cases (also of other products), "Reifegradspiegel inquires", quality method check, production planning as well as the technological design-description are considered. The definition of the accrual heights is purpose of these efforts. The amount is the sum of the different mathematical products (Figure 13).

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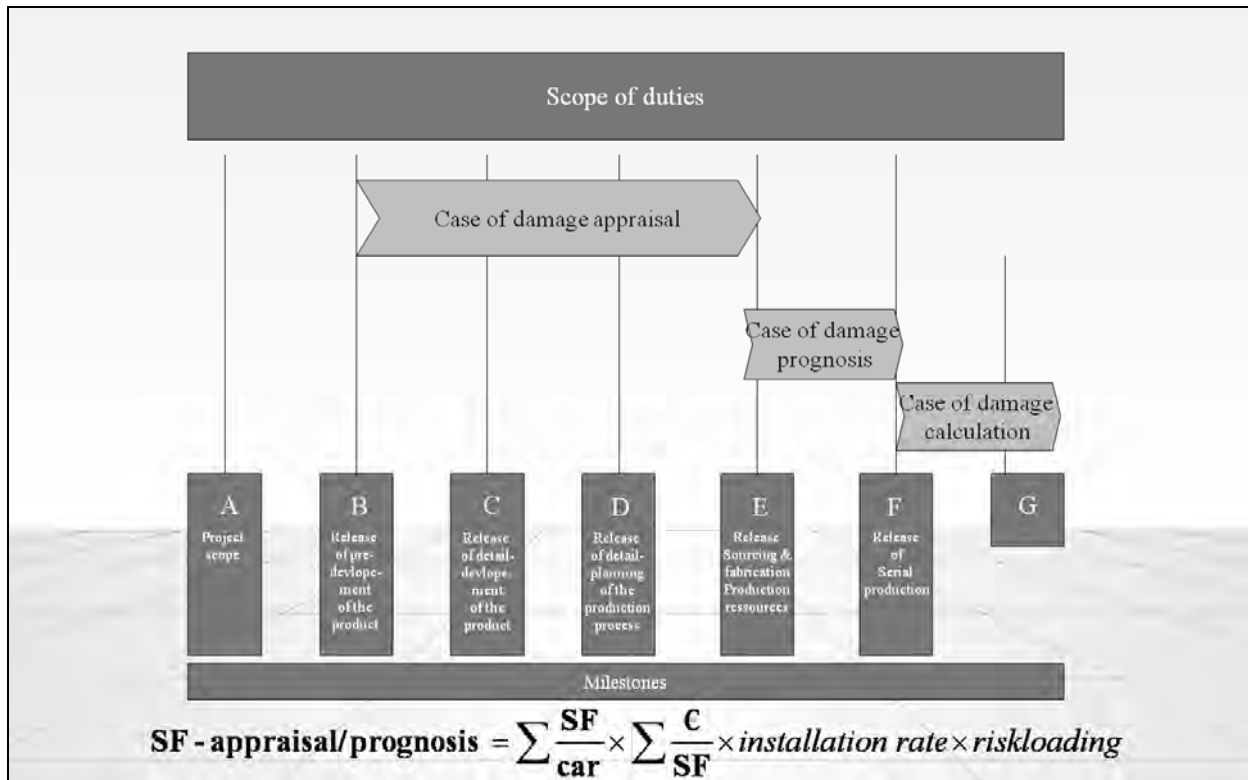
Figure 13: *Case of damage appraisal/prognosis*

With assistance of the 3P-Workshops the production of goods and services can proceed more efficiently. A large section of failures emerging after SOP can be prevented.

Nevertheless the focus is set on the process improvement and not on the classical failure prevention. At this stage the quality method FMEA can support the 3P- Workshops. To a large degree the participants (specialists, experts) of the 3P- Workshop and the FMEA are the same. Because of the visualisation during the 3P-Workshops the Data base which can be used in the FMEA is very large. The product as well as the process could be verified preventive. For that it makes sense to check the elaborated improvements according to the 3P-Workshops at the end of the creative phase and to make necessary adjustments.

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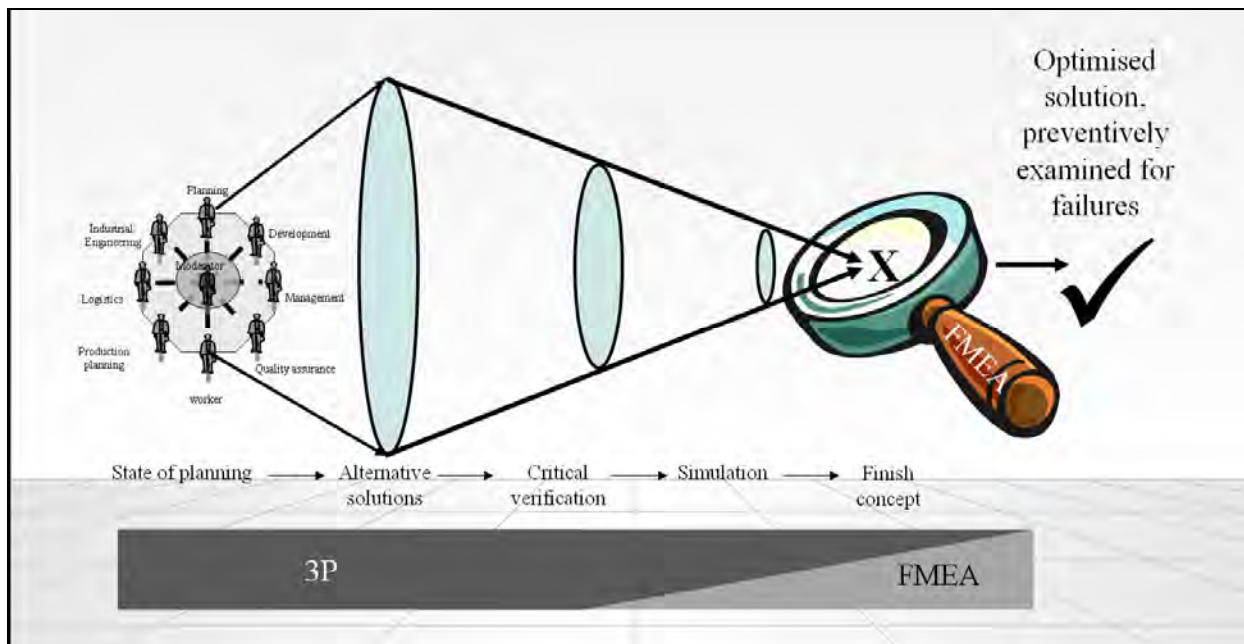
Figure 14: *Combination 3P & FMEA*

The products and processes are improved inside the 3P-Workshops appropriate to the special request of the planning. On this account changes which are resolved in the 3P- Workshops within vital components and critical processes must be checked preventively. For this purpose as already mentioned the quality method FMEA has been established.

It can easily be demonstrated at the example of the Process-FMEA (P-FMEA). The purpose of the P-FMEA is to check which failures could arise inside the production process (false sheeting, interchanges, damages, non capable process etc.) and how these failures could be prevented. These remedial actions could be verified during the 3P Process and the process accordingly changed. To simplify, according to the creative phase the inspection occurs.

It is necessary to evaluate the performance of the 3P-Workshops combined with FMEA because of the prognoses/approximation of the costs by pay cases which is directly linked with the performance of the workshop. This applies to both the actual process and the transformation inside the organisation.

5   Measuring Capability- and Maturity Level of the processes and organisation

"Today's problems come from yesterday solutions…" (Senge's law)

Defect cases can only occur after the SOP and therefore be measured. In order to reduce the pay cases of damage one has to attest that every possible failure during the production process is regarded and eliminated. On this account no accrued liabilities for pay cases of damage must be formed. It may be noted here that this is not possible in reality because pay cases of damage have their origin in a multiplicity of reasons which cannot be respected during the product development process (vendor parts, suppliers etc.). Failures which could lead to pay cases of damage could be avoided by the use of quality methods. These pay cases could be subtracted of the sum of the accrued liabilities and the accordingly damage case prognoses. Due to the great chronological offset between the realisation of the quality methods and the

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result of the same ones it is necessary to have a gauge which approves an inference for the defect case prognosis.

It is arguable whether the result of the method is realistic. The probability that the result of the quality method will be stated in the production process enhanced so much the better the quality method has been accomplished before the SOP. For that reason the defect case prognosis could be lowered.

The Capability Maturity Model Integration (CMMI) is used in the software industry as a gauge for the development progress and therefore as an inference on productivity and quality (Kneuper, 2003)

For this purpose the realisation of the several methods (process layer) is analysed as well as the maturity level of the organisation (Figure: 15).
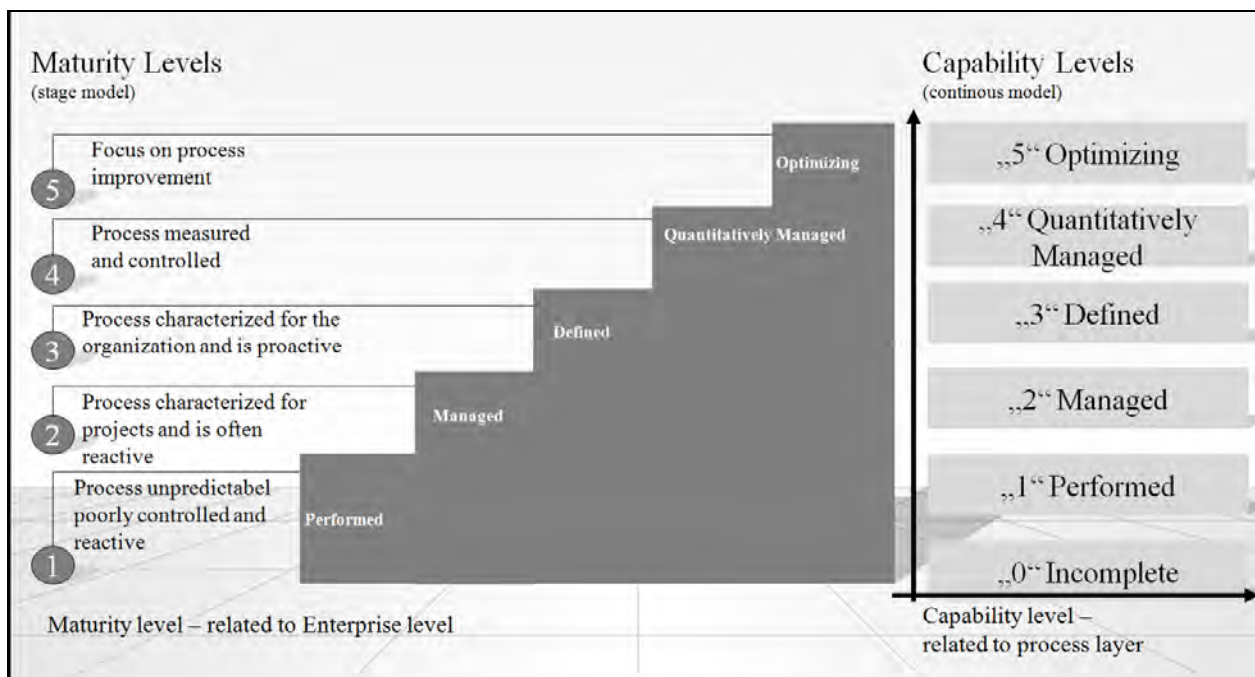
Figure 15: *CMMI-Model*

Within the framework of the capability measurement it is checked how the individual method was carried out at itself (topic, preparation, participant, procedure, documentation, measure interrogation etc.). The stage of maturity is not only measured by the grade how the processes are embedded in the product development process, in this case the quality methods, but also how they are put into practice in the different projects. The higher the capability respectively maturity level the stronger the defect cases could be lowered.

6   Conclusion

The global automotive industry struggles with sinking margins and an increasing overcapacity about 20% (Schubert, 2006). This competition will still intensify by the time the Chinese automotive manufacturers press forward on the global market. Only those manufacturers will overcome the challenge who are capable to serve the triad of success - quality, deliverance and costs for the customer. Not surprisingly, that the automotive manufacturers must improve continually. This approach is widespread after the SOP (CIP, valuestreammapping). Since the problem focus lays on the actual production process an optimisation of the product development process itself was not strong enough considered. Moreover it became clear, that

a great optimisation potential is available in the product development process, in particular in the product development and verification as well as the planning and verification of the production process. Not surprisingly, the success of Toyota is based on the procedure within the product development process. The avoidance of waste and therefore the concentration on value adding processes for the customer has a high priority. These are the components of the TPS which is put into practice continuously. In doing so the creative potential of their employees has been fully taken up in the production development process as well as after the SOP. A great relevance is set on the so-called "try-storming". New approaches result through testing (1:1 Simulation), ideas could be easier proved concerning to their feasibility. The European and American automotive manufacturers are still detaining to their pattern of thought (Push-systems). The effect is noticeable; the western automotive manufacturers still search solutions for the wrong problems (Morgan/Liker, 2006).

The basic approach to use CIP before SOP (→3P) proves to be a complete success. The basic prerequisite is to break up the old paradigm (with the knowledge that complexity forces failures (Nakao, 2007) the simple, capable solution must be found). For that the creativity potential of the employees must be used more efficiently. The employee who has to built the devices faultless and free of waste has to be in the centre of the planning. For this reason, a special role comes up to planning as interface between development and manufacturing, since it must fulfil both the requirements of the development and those of the manufacturing. With the help of the 3P-method it is possible to use the creative potential of the team members better. Problems and/or improvement suggestions can be examined by the common exchange faster on their feasibility. Furthermore, by combining 3P with the method of the FMEA, one can extend the preventive use of 3P, since both the wasting and the potential failures are prevented in this way. Failures become questions, questions becomes changes (Lotter, 2007). This leads to the fact that the case of damage prognosis can be decreased, and thus the costs noticeably reduced. Depending upon the automotive manufacturers savings up to one billion € can be realised by a 10% drop off.

To sum up, the way of employing the methods is important in order to lower the case of damage prognosis accordingly. It goes without saying that pretending the methods will not be leading to the desired results. Essentially the capability and maturity level of the organization must be measured. This is important, as these determine the success of the methods, and thus the case of damage prognosis affect. The digital factory can support but not replace the methods (e.g. Augmented Reality).

The key to success is to understand both, the problem and the solution, perfectly (Spear, 2004). For that reason the journey is the reward.

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An Empirical Study of the Impact of Management Standards on the Innovation Processes

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Abstract

Purpose- The aim of this research is to respond, from an empirical point of view, to the next question: "Does management systems based on standards hinder innovation processes?".

Methodology- In order to achieve this objective, an empirical work with the participation of 249 companies, in the framework of a research project called "Integrated Management Systems (IMS) in the Spanish companies" (SEJ2006-00682/ECON financed by the Ministry of Science and Technology within the aid program for R+D project) carried out from January to April 2006, is presented in this paper.

Findings- Principal findings of the survey of 249 Spanish organizations registered to both the ISO 9001 and ISO 14001 standards which was illustrated here are: Managers and people involved in standardized management systems gave less importance to the statement that standards hinder innovation processes, although not with a statistically-significant difference compared to the other types of managers who responded to the survey. The importance given to the sentence "MSSs hinder innovation" decreased as more MSSs were considered for implementation in the future.

Originality/value- The majority of the work on innovation and quality management systems available in the current literature is based on the framework of Total Quality Management. In difference, the empirical analysis illustrated in this paper is focused on the various characteristics of standardized management systems, for example their current and future application and integration.

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1 Introduction

The academic literature of empirical studies that have analysed the effects of QM (Quality Management) in companies' performance is very extensive (see for literature reviews Sila and Ebrahimpour, 2002; Heras, 2006). Empirical studies seem to have evidenced that the implementation of methodologies and tools that are linked to QM (e.g. implementation of TQM programs based on EFQM, ISO 9001 or other similar models) have improved companies' performance, although there is a big discussion on this issue.

Although the relationship between the implementation of Quality Management Systems (QMSs) and the innovation capacity of the organizations has been broadly studied from a theoretical point of view (see Prajogo and Sohal, 2003; Singh and Smith, 2004; Prajogo and Sohal, 2004a; Feng et al., 2006; Hoang et al., 2006; Martínez-Costa and Martínez-Lorente, 2008), there are not many empirical studies in the literature that are related to the impact of Management System Standards (MSSs) on the innovation capacity of organizations.

When considering the correlation between MSSs and innovation, the literature generally presents different views. From the point of view of Kondo (2000): "It is pointed out that work standardization conflicts with motivation, since it restricts the creativity and ingenuity of the people engaged in the work and reduces their opportunities to exercise those faculties". However, Naveh and Marcus (2004), regarding the usefulness of the ISO 9001 standard to achieve innovation performance, consider that innovation is dependent upon the level of the standard adoption in an organization. According to Bossink (2002), the standard has to be really assimilated in an organization first, and subsequently, by going beyond its established requirements, ISO 9001 can become an important basis for innovation processes in the organization. Since innovation it is not one of the "Eight Quality Management Principles" (see ISO 9000: 2005), ISO 9001 can be considered as a platform to innovate only by going beyond its compulsory requirements (Bossink, 2002).

Considering the previous theoretical work, the aim of this research is to respond, from an empirical point of view, to the following question: "Do Management Systems (MSs) based on standards hinder the innovation processes in an organization?" In order to address this question, empirical research illustrated in the next section was performed.

2 Data collection

In 2006, within the framework of a research project called "Integrated Management Systems (IMS) in Spanish organizations", a questionnaire based on the existing theoretical and empirical literature was sent out to managers of ISO 9001: 2000 and ISO 14001: 2004 –registered organizations in the Spanish Autonomous Communities of the Basque Country and Madrid. These two communities, in addition to Catalonia, have the highest number of MSS certificates in the Spain. This specific research follows a previous research in Catalonia, the details of which can be found in Karapetrovic et al. (2006).

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The questionnaire was mailed, with a prepaid postage envelope, to 525 organizations with both the ISO 9001 and the ISO 14001 certificates in the Basque Country, and 525 of the 990 such organizations in Madrid. After the telephone calls to follow-up on the reception of the survey, the questionnaires were sent back by 122 companies in the Basque Country and by 132 organizations in Madrid. This represents a 24.19% response rate (Heras et al., 2007). The aim of the questionnaire was to obtain empirical-based answers to analyze both the current status and the future evolution of the application and integration of international MSSs within organizational management systems. One of the survey questions addressed the perceived importance of the following affirmative sentence: "Management system standards hinder innovation processes", which became the Key Statement (KS) analyzed in this paper. In accordance with this KS, the following two main hypotheses and seven sub-hypotheses were tested.

Hypothesis 1.
Importance attributed to the Key Statement varies among organizations depending on the implemented MSSs and their integration.

Sub-hypothesis 1. Importance attributed to the KS varies among organizations with a different number of implemented MSSs.
Sub-hypothesis 2. The variation within the importance attributed to the KS is correlated with the different number of MSSs implemented in organizations.
Sub-hypothesis 3. Importance attributed to the KS varies among organizations with different integration levels of the implemented MSSs.

Hypothesis 2.
Importance attributed to the Key Statement varies among organizations depending on the implementation of new MSSs:

Sub-hypothesis 4. Importance attributed to the KS varies among organizations which considered a different number of MSSs important to implement in the future.
Sub-hypothesis 5. The variation within the importance attributed to the KS is correlated with the number of MSSs considered important for the future implementation in the organization.
Sub-hypothesis 6. Importance attributed to the KS varies if the implementation of an innovation management standard is considered important for the organization or not (In Spain, as in a number of other countries, for example the United Kingdom, there already exists an innovation management standard, namely the UNE 166 000 series).
Sub-hypothesis 7. Importance attributed to the KS varies among organizations with different views on the most preferable option for the future MSS implementation.

A summary of the results of the testing of these hypotheses is presented in the following section. Full results can be found in Castillo (2007).

3   Results

There were 249 valid responses to the key statement. Considering a total population of 1.515 certified organizations in the Basque Country and Madrid, and a confidence level of 95%, the admissible margin of error is 6.1%. In general, it can be said that the majority of the respondents (64.3%) gave a low level of importance to the statement:

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"Management system standards hinder innovation processes" (Figure 1. Responses to the Key Statement). Namely, 47%, or almost a half of the respondents considered this sentence as "Not Very Important", while 17.3% considered it as "Somewhat Important". 28.5% of the respondents adopted a "Neutral" or a more conservative position considering the sentence as "Important". And just the 7.2% of respondents attributed the "Extremely important" alternative to the statement. Therefore, it seems clear that for the majority of the organizations, MSSs do not hinder innovation processes.
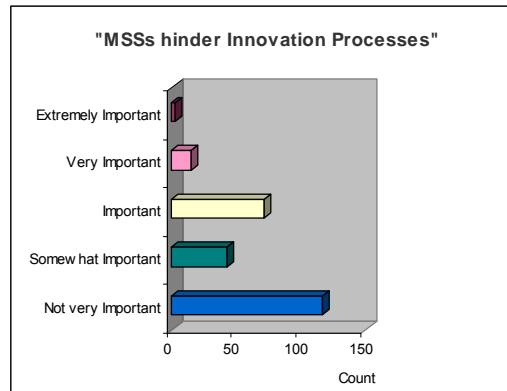
Figure 1. Responses to the Key Statement

Before analyzing the proposed hypotheses, the first analysis carried out was related to the respondents and the various company characteristics. However, none of the analyzed variables demonstrated any difference between respondents. In other words, we did not find any statistically-significant differences, with a 95% confidence level, in the responses to the key statement depending on the size, the type of the business activity (Production / Services), the industry sector, or the customer of the organization (Final Customer/ Intermediate Customer / Both). The same was true for the regions where the organizations were based (Basque Country / Madrid). On the other hand, the position of the respondent in the organization (General Manager / Management System Director / Other Area Manager) indicated some differences, however these differences were not statistically significant. This result seemed to show that general managers and management system directors gave less importance to this sentence than other area managers. Overall, these results, presented in Castillo (2007), allow us to work on the hypotheses without any kind of stratification.

Non-parametric tests can be used to test the hypotheses. Depending on the variable measurement levels, there are two specific non-parametric tests used in this work: Mann-Whitney and Kruskal-Wallys tests to analyze if independent samples come from the same population, and the Spearman correlation coefficient to analyze the correlation between variables. The following paragraphs represent the results of this analysis.

Sub-hypothesis 1 is rejected with a p-value=0.442 for the confidence level of 95% (Table I. Kruskal-Wallis Test Results for Sub-Hypothesis 1). The "Number of MSSs implemented" refers to the number of MSSs implemented in the organization. The minimum is two, since organizations with at least ISO 9001 and 14001 were included in the survey. Checking the mean rank and the percentages obtained seems to indicate that the importance attributed to the key statement decreases as the number of implemented standards increases. However, these differences are not significant.

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Sub-hypothesis 2 is also rejected. Considering that the Spearman correlation coefficient is not significantly different from zero, there is no correlation between the importance attributed to the key statement and the number of different MSSs implemented in the organization.

Sub-hypothesis 3 is rejected with p-value=0.706 for the 95% confidence level. Although the differences are not statistically significant, organizations that did not integrate their standardized MSs gave more importance to the key statement. The mode in this case is the

% within Number of MSSs Implemented

		Importance of "MSSs hinder innovation processes"					
		Not very Important	Somewhat Important	Important	Very Important	Extremely Important	Total
Number of MSSs Implemented	2	48,6%	18,1%	26,1%	5,8%	1,4%	100,0%
	3	42,6%	13,1%	36,1%	6,6%	1,6%	100,0%
	4	36,7%	23,3%	33,3%	6,7%		100,0%
	5	61,5%	7,7%	23,1%	7,7%		100,0%
	6	66,7%	33,3%				100,0%
	7	100,0%					100,0%
	9	50,0%	50,0%				100,0%

Test Statistics[a,b]

	Importance of "MSSs hinder Innovation processes"
Chi-Square	5,833
df	6
Asymp. Sig.	,442

a. Kruskal Wallis Test
b. Grouping Variable: Number of MSSs Implemented

Table I. Kruskal-Wallis Test Results for Sub-Hypothesis 1 (Number of MSSs Implemented)

same for organizations that have made or not integration efforts. The mean rank is higher for organizations without the integration, and these organizations had a higher percentage of answers considering the key statement as either "very important" or "extremely important".

Considering the test results on the first three sub-hypothesis, we have to reject the main Hypothesis 1 and conclude that "The number of implemented MSSs and their integration does not affect the perception of the organizations regarding MSSs being a possible barrier to the innovation processes".

In order to analyze Hypothesis 2, four sub-hypotheses have been tested, with the following results.

Sub-hypothesis 4 is rejected for the confidence level of 95% (Table II. Kruskal-Wallis Test Results for Sub-Hypothesis 4). However, considering that the p-value is 0.149, it could be accepted for a lower confidence level of 85.1% (1 - p-value). Namely, the importance attributed to the key statement may vary depending on the number of MSSs considered important for future implementation in the company. Checking the mean rank and the percentage within the MS future implementation level seems to indicate that the importance given to the key statement decreases with the propensity to implement a higher number of management system standards.

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		Importance of "MSSs hinder innovation processes"					
		Not very Importan	Somewha Importan	Importan	Very Important	Extremel Importan	Total
Number of MSSs for future application	2	34,4	18,8	35,9	10,9		100,0
	3	46,6	15,5	29,3	5,2	3,4	100,0
	4	40,0	13,3	43,3	3,3		100,0
	5	50,0	22,7	13,6	13,6		100,0
	6	50,0	18,8	31,3			100,0
	7	71,4	7,1	21,4			100,0
	8	71,4	28,6				100,0
	9	75,0	25,0				100,0
	10	50,0	20,0	20,0		10,0	100,0
	11	60,0		20,0	20,0		100,0
	12	50,0	16,7	33,3			100,0
	13		100,0				100,0
	14	80,0		20,0			100,0
	15	33,3	33,3	33,3			100,0
Total		47,0	17,3	28,5	6,0	1,2	100,0

Test Statistics ^{a,b}

	Importance of "MSSs hinder Innovation Processes"
Chi-Square	17,021
df	12
Asymp. Sig.	,149

a. Kruskal Wallis Test

b. Grouping Variable: Number of MSSs for future application

Table II. Kruskal-Wallis Test Results for Sub-Hypothesis 4
(Number of MSSs for future application)

Sub-hypothesis 5 is also accepted (Table III. Results from the Spearman correlation coefficient in Sub-Hypothesis 5). The correlation coefficient is -0.2 and the p-value= 0.001. Hence, there is a significant negative weak correlation between the importance given to the key statement and the propensity to implement a higher number of MSSs in the future.

Correlations

			Importante of "MSSs hinder Innovation Processes"	Number of MSSs for future application
Spearman's rho	Importance Standards As a Barrier to Innovation	Correlation Coefficient	1,00	-,20 **
		Sig. (2-tailed)	.	,00
		N	249	249
	Number of MSSs for future application	Correlation Coefficient	-,20 **	1,000
		Sig. (2-tailed)	,00	.
		N	249	256

** Correlation is significant at the 0.01 level (2-tailed).

Table III. Results from the Spearman correlation coefficient in Sub-Hypothesis 5

Sub-hypothesis 6 is rejected for the confidence level of 95% and the p-value=0.22 (Table IV. Mann-Whitney Test Results for Sub-Hypothesis 6). The importance attributed to the key statement is smaller if the future implementation of an Innovation MSS is considered important for the company . In fact, there is a higher percentage of organizations which consider the key statement as "Important" and "Very important" in the group which considers that the Innovation MSSs should not be implemented. However, taking into account the hypothesis testing results, these differences are not statistically significant.

		Importance of "MSSs hinder innovation processes""					
		Not very Important	Somewhat Important	Important	Very Important	Extremely Important	Total
Importance of an Innovation MSS	Implementation should be done in the future	53,7%	18,5%	22,2%	3,7%	1,9%	100,0%
	Implementation should not be done	46,0%	15,0%	30,1%	8,8%		100,0%
Total		48,5%	16,2%	27,5%	7,2%	,6%	100,0%

Test Statistics ^{a}

	Importante of "MSSs hinder Innovation Processes"
Mann-Whitney U	2720,000
Wilcoxon W	4205,000
Z	-1,221
Asymp. Sig. (2-tailed)	,222

a. Grouping Variable: Importance of an Innovation MSS

Table IV. Mann-Whitney Test Results for Sub-Hypothesis 6
(Importance of an Innovation MSS)

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The last *sub-hypothesis* (Table V. Kruskal-Wallis Test Results for Sub-Hypothesis 7), is also rejected with a p-value of 0.368 for the confidence level of 95%. Organizations that consider the implementation of MSSs and excellence models as suitable options for the future give less importance to the key statement than the organizations which do not intend to implement any MSSs or excellence models. This result can be confirmed by checking the mean rank and the percentage within the general view of future implementations. However, these differences are not statistically significant.

% within Options suitable for future

		Importance of "MSSs hinder innovation processes""					
		Not very Important	Somewhat Important	Important	Very Important	Extremely Important	Total
Options Suitable for future	Management Standards	51,9%	19,4%	25,0%	2,8%	,9%	100,0%
	Excelence Models - TQM	50,6%	14,3%	26,0%	7,8%	1,3%	100,0%
	No One	40,0%	16,7%	36,7%	6,7%		100,0%
Total		49,8%	17,2%	27,0%	5,1%	,9%	100,0%

Test Statistics a,b

	Importante of "MSSs hinder Innovation Processes"
Chi-Square	1,998
df	2
Asymp. Sig.	,368

a. Kruskal Wallis Test
b. Grouping Variable: Options Suitable for future

Table V. Kruskal-Wallis Test Results for Sub-Hypothesis 7
(Options Suitable for Future Use)

Considering the previous sub-hypothesis we can conclude the following: Organizations that intend to implement more MSSs perceive standardization as a possible barrier to the innovation processes to a lesser degree. However, there is no such difference between the organizations that intend to implement new innovation management system standards and the rest. Also, no differences were detected between organizations intending to implement a management system standard or a business excellence model and the ones that did not intend to do so.

4   Conclusions

The majority of the work on innovation and quality management systems available in the current literature is based on the framework of Total Quality Management. In difference, the empirical analysis illustrated in this paper is focused on the various characteristics of standardized management systems, for example their current and future application and integration. The principal findings of the survey of 249 Spanish organizations registered to both the ISO 9001 and ISO 14001 standards which was illustrated here are:
The assumptions related to the possible differences depending on the organizations' characteristics such as size or industry sector were rejected. This finding could be understood with the idea that management system standards (MSSs) are generic, therefore making organizational characteristics not affect the perceptions regarding their innovation performance.
Managers and people involved in standardized management systems gave less importance to the statement that standards hinder innovation processes, although not with a statistically-significant difference compared to the other types of managers who responded to the survey. This finding is most likely due to their position and involvement with MSSs allowing them to develop a balanced view of the company's characteristics at operational and strategic level (Prajogo and Sohal, 2004b).
There were no differences in the perception of MSSs as a barrier to the innovation processes depending on the number of MSSs implemented in an organization and whether or not the corresponding standardized management systems were integrated.
The importance given to the sentence "MSSs hinder innovation" decreased as more MSSs were considered for implementation in the future.

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There were also some differences when contrasting other MSS-related variables with the importance given to the statement that MSSs hinder innovation processes. However, those differences were not statistically significant.

Following the work of McAdam et al, 1998, future research will focus on comparing and analyzing quality MSSs and innovation management standards in order to see how complementary they are.

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Impact of Ethical Practices on Productivity of Software Development Organizations in Pakistan

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Abstract – Ethics play an immensely important role in creating quality cultures in organizations. The ethical practices have been consistently increasing in IT business for long-term sustainability. Unfortunately in the third world countries like Pakistan there is not much awareness of Ethics. The study analyzes selected sample of organizations which follow some good ethical practices to maintain a positive image among its customers. It will highlight the role of ethical practices in the business success of such organizations. Software engineering is different from other engineering disciplines of its hidden complexities; the role of ethics is felt even more in software industry. This paper will show that role and will encourage other organizations to involve in ethical practices. In this paper authors will try study what role ethics have to play in productivity. Do ethical practices help increase productivity? Do unethical practices cause decrease in productivity?

I. INTRODUCTION

Software and Telecom companies in Pakistan and South Asia in general are offshore development centers and some are multinational companies. The aim of such organizations is to stabilize economic infrastructure leading to opportunities for collaboration with foreign investors and professionals, breaking down the geographic boundaries. In modern days, there are various tools and techniques available in order to measure project performance but it is hard to focus on ethical issues. There is plenty of evidence that unethical behavior can cost organization's reputation, Moreover, organization that are perceived as ethical are more likely to build trust between their shareholders, employees and customers. However, every organization is likely to identify some degree of ethical issues, such as intellectual property rights, privacy of sharing sensitive information, trust, motivation, leadership. In this paper, authors will argue the impact of ethical practices on productivity improvement in software development organization in Pakistan and northern region and central Punjab in particular[1]. All of these issues directly affect on organization's productivity and need to be addressed to create the proper understanding to manage an effective project. This paper focuses on issues and challenges faced by such organizations. Paper concludes with recommendations to avoid or at least minimize the influence of such issues.

II. AWARENESS OF ETHICS

Authors conducted surveys in some notable software organizations in Northern and Central Punjab region of Pakistan. The purpose of questionnaire was to investigate the level of awareness of business ethics at organizational and personal level. The response was really a mix bag. Let us see answers to some selected question[2].
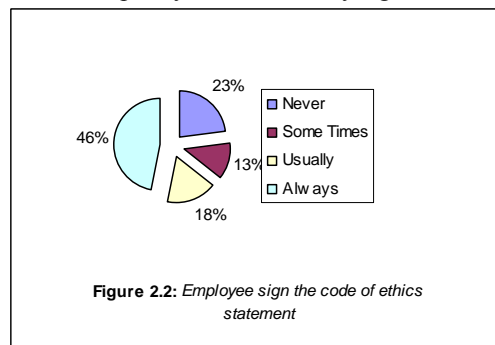
a. Existence of ethical policy:

It is very nice to note that most of Pakistani software development companies are having a written ethical policy. You can see the response of employees in figure 2.1.


Figure2.1: *Written ethics policy in Organizations*

b. Do employee sign ethical policy

It is also a good sign that almost 50% of employees sign the ethical policy as Indicated by figure 2.2.

Figure 2.2: *Employee sign the code of ethics statement*

c. Reward of behaving ethically

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One important question, are ethical behaviors rewarded? The disappointing fact is that only 5% of the employees thing that their company rewards for behaving ethically[1]. The graphical proof of fact is shown in figure 2.3.


Figure 2.3: Is ethical behaviour rewarded
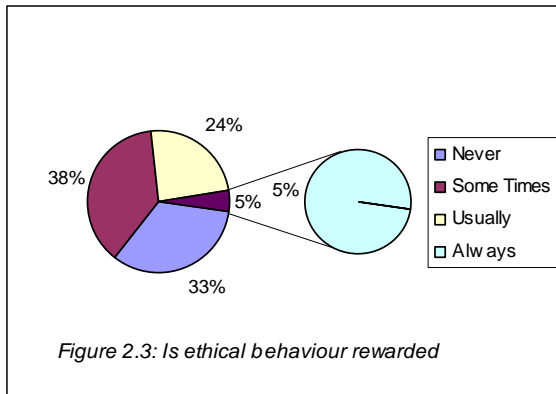
d. Favoritism by leaders

It is most disappointing to note that most employees are not satisfied by theirs leads. They are of view that leaders employ favoritism. Figure 2.4 says it all.

Fig 2.4: Favoritism by leaders
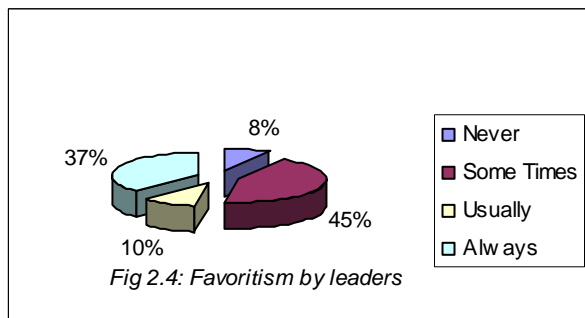
e. Honesty of leaders

Most employees feel that their leaders are honest and lead by example. The survey results are shown in figure 2.5.

Fig 2.5: are leaders in your organization honest ?
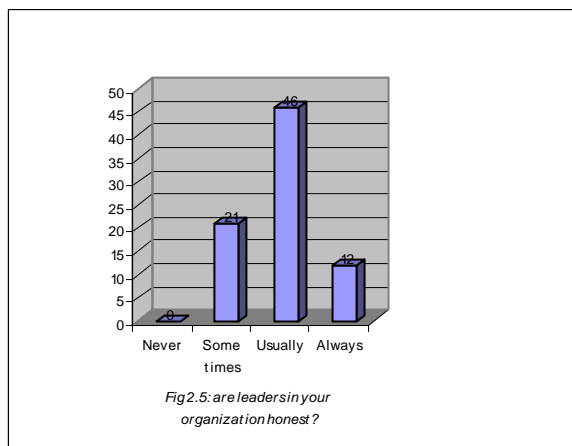
Many software development organizations in Pakistan, they are in dark about the use of e-mail in their organizations. Authors conducted research into how employee us or misuse the e-mail and internet[1].

They also admit that use of internet, instant messaging and e-mail at office negatively affects your productivity. In a survey of employees respondents said they would agree to being monitored as long as they were informed first. "Another important aspect of managing the ethical risk created by communication technology, but different companies has their own set of procedure to follow their employee's email and internet usage[3]. There are some practical steps that managers can take to tackle the ethics risk posed to their organization by communications technology[1].

III. ETHICS AND PRODUCTIVITY

A. Personal use of company resources

We have concluded that personal use of internet and especially that of instant messaging distracts an employee's attention and break attention from office work and impacting the productivity negatively. It is indicated in the figure 3.1.
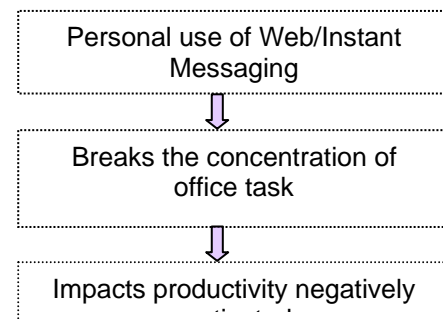
Fig 3.1: *Chain reaction for personal user of company resources*

B. No protection of copy writes

If an organization does not create a culture of protecting copy write laws, its employees will install non-licensed software. This will make company reluctant to be audited for quality certifications. The fact is shown in figure 3.2.
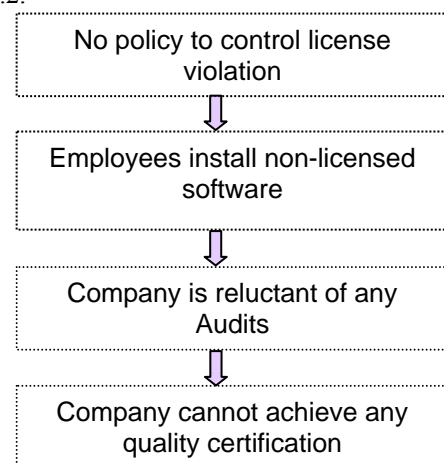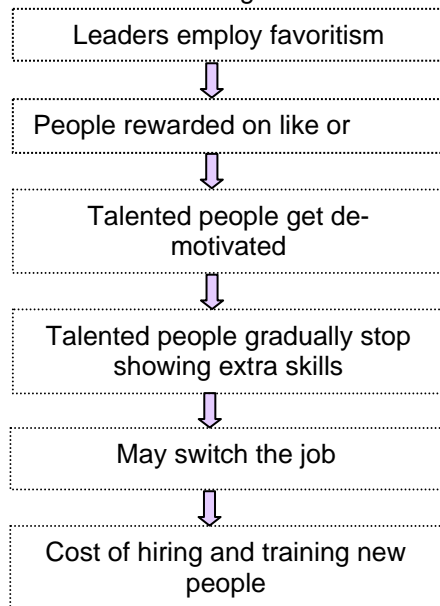

Fig 3.2: *Chain reaction of not using licensed software*

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C. Favoritism
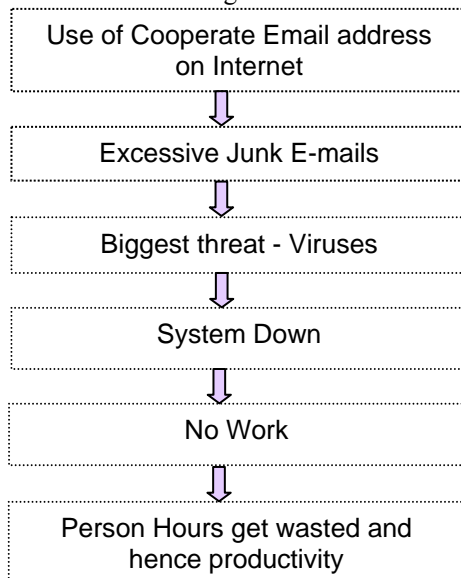
Employing favoritism is one the worst unethical practice in organizations[4]. It has many chain reactions as indicated in the figure 3.3.

```
┌─────────────────────────────┐
│   Leaders employ favoritism │
└─────────────────────────────┘
              ⬇
┌─────────────────────────────┐
│   People rewarded on like or│
└─────────────────────────────┘
              ⬇
┌─────────────────────────────┐
│   Talented people get de-    │
│          motivated           │
└─────────────────────────────┘
              ⬇
┌─────────────────────────────┐
│  Talented people gradually   │
│  stop showing extra skills   │
└─────────────────────────────┘
              ⬇
┌─────────────────────────────┐
│       May switch the job     │
└─────────────────────────────┘
              ⬇
┌─────────────────────────────┐
│  Cost of hiring and training │
│          new people          │
└─────────────────────────────┘
```

Fig 3.3: *Chain reaction of employing favoritism*

D. Non-business use of Cooperate E-mail

Some are very careless about use of their corporate e-mail address. They give it to friends and family members. This causes the outsiders to send junk emails. Some times these e-mail contain viruses and hence causes the system down time[5]. You can at times lose valuable customers while the system is down because excessive down time causes dissatisfaction in customers. See the chain reaction in figure 3.4.

```
┌─────────────────────────────┐
│  Use of Cooperate Email      │
│  address on Internet         │
└─────────────────────────────┘
              ⬇
┌─────────────────────────────┐
│    Excessive Junk E-mails    │
└─────────────────────────────┘
              ⬇
┌─────────────────────────────┐
│    Biggest threat - Viruses  │
└─────────────────────────────┘
              ⬇
┌─────────────────────────────┐
│         System Down          │
└─────────────────────────────┘
              ⬇
┌─────────────────────────────┐
│           No Work            │
└─────────────────────────────┘
              ⬇
┌─────────────────────────────┐
│  Person Hours get wasted and │
│      hence productivity      │
└─────────────────────────────┘
```

Fig 3.4: *Chain reaction of employing favoritism*

E. Confidentiality

If organization does not stress the employees to main confidentiality of business secrets, it may cause big problems. Good thing we noted was that some companies make employees sign a Non-disclosure Agreement (NDA). An example of breach of such clause and its trickle effect is shown in figure 3.5.

```
┌─────────────────────────────┐
│   Employee used to share     │
│       their salaries         │
└─────────────────────────────┘
              ⬇
┌─────────────────────────────┐
│      Temporary Chaos         │
└─────────────────────────────┘
              ⬇
┌─────────────────────────────┐
│        Uncertainly           │
└─────────────────────────────┘
              ⬇                  ⮀
┌─────────────────────────────┐   ┌──────────────┐
│   Frustration / low morale   │   │   Employee   │
└─────────────────────────────┘   │   Turn Over  │
              ⬇                    └──────────────┘
┌─────────────────────────────┐
│        Dishonesty            │
└─────────────────────────────┘
              ⬇
┌─────────────────────────────┐
│      Low productivity        │
└─────────────────────────────┘
```
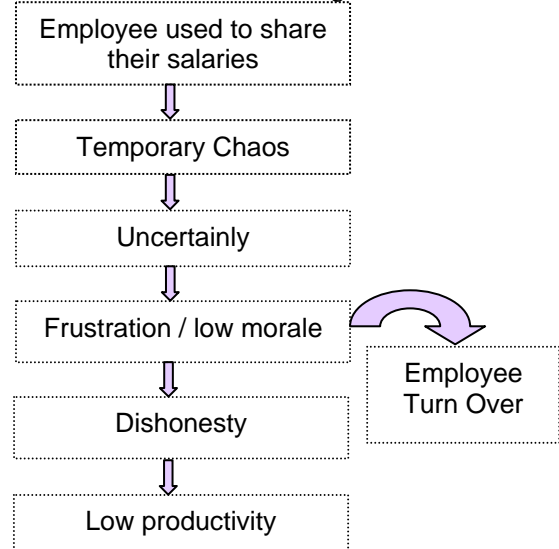
Fig 3.5: *Chain reaction of employing favoritism*

F. Unrealistic commitments

Pareto Principle is very commonly seen in software projects [5]. When every one believes that they have done almost 80 percent of the project, but last 20 percent in reality proves equal to 80 percent. In the last stages of project, the fear of schedule over-run increases and hence almost everyone in the team has to stay late to try to meet the schedule.

IV. RECOMMENDATIONS

a. Training

Communication alone is not sufficient to convert values into action. Employees may think they know how to make an ethical decision, but they may not know how to think though the process of evaluating potential courses of action and their consequences, or understand what the organization would like them to do in difficult circumstances. This is particularly true when employees come from diverse backgrounds, cultures and life experiences. A program of ethics training is crucial, and to be most effective it should allow employee to exchange views with each other about the importance of ethics and about compliance and values that specifically relate to their daily work. Some good ethics training sessions are delivered online, enabling employees to take

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the interactive courses individually and spend much time as they need reviewing various topics. Author conducted survey in software development in order to assess whether they ever conduct training on code of ethics or not, amazingly 44% of the organization never provide training on ethics practices. Only 4% respondent says that they always receive training on business ethics [1].

Fig 3.6: *Does Organization conduct training on Professional ethics*

b. Trust / Respectfulness

In today's business context, trust almost always means trustworthiness, inspiring customers, vendors, regulators, the media and the public to feel confident in and rely on a person, team, organization, product or service but how do you create trustworthiness? One of the best ways is to act with trustfulness, since trusting others encourages them to trust you.

c. Talent Retention

A survey shows that those software development organization practices ethical values in the organization; they have less employee turnover rate than those who never invest in this area.

CONCLUSION

Business ethics education is rather hit-and-miss; some organizations do invest in ongoing training, to keep their employees interested. For many organizations, though, such education does not make use of real issues that employee, encounter, best practices indicates that realistic examples of employee groups can provide more awareness of ethical issues. Few organization offer performance review that include reference to ethical issue[6]. A best practice indicates that the development of key performance indicators relating to ethics is an excellent way of reinforcing and perhaps rewarding ethical conduct. At one extreme performance management and reward system might actually reinforce unethical conduct. It is crucial there, that companies develop system that employees have confidence in and that are seen to be working. Ultimately, increased ethics practices in public will to manage / reduce risk in the workplace. By applying best practice approaches organizations will have more confidence in order to get maximum return on invest by satisfying customer needs.

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Impact of Ethical practices on Quality of Services of bile Telecom Companies: Case Study of Pakistan

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Abstract: The mobile telecom industry in Pakistan is blooming and has fierce competition between different cellular service provider companies. Only a company with its better Quality of Service (QoS) can survive. By quality of service, we mean how well a company has designed its processes to meet the customer requirements and satisfaction and which ethical practices are followed by the companies to enhance their customer base. The paper considers factors such as new connections & billing process, branding, marketing, policy on soliciting calls, hidden charges and value added services such as SMS, MMS, GPRS etc. to identify that how ethics are practiced in the mobile telecoms companies in Pakistan. As the value system of each society is different, so paper focus will be on value and ethics system that is being followed in a developing country like Pakistan. It will try to establish the link how ethics help the companies to improve their Quality of Service, hence increase their customer's satisfaction.

Key Words: Pakistan, Telecom, Quality of Service, QoS, Ethics, Customer Satisfaction, Cellular Company

Objective

The objective of this study is to explain relation between the good ethical practices and quality of service for telecom companies in Pakistan. This research will try to figure out

- What ethical practices are followed in Pakistan telecom industry?
- Are there any unethical practices?
- Does being ethical pay reward.

At the end we will provide some suggestions to improve the overall ethical quality of services.

Hypothesis

Telecom sector has lots of collaboration and interaction with customers, which is why it is very important for them to practice ethics in their organizations. This research wants to determine the impact of ethical practices on the quality of service of a telecom company hence increase in productivity and profitability.

Scope

Our research scope is limited to cellular mobile companies working in Pakistan. And its focus is on the effect of ethics on the service these companies are giving to customers.

Telecom Industry in Pakistan

The mobile telecom industry in Pakistan is blooming. At 2006 year end the total subscribers were 48.2 million. In June 2007 the total mobile users reached over

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63 million. Based on numbers published at PTA website for 2007, the total number of subscribers was 76.6 million and has fierce competition between different cellular service provider companies. These companies are competing to capture the market share as much as possible (9).Winner of this combat will be who will have better quality of service supported by ethical practices.

Ethics and Quality Relationship

A number of advocates for quality contend that firms who embrace TQM will automatically and naturally act in ethically sound ways. Any organization can achieve excellence with their cost effective solutions, quality of products and services, speed of availability of service and products, value system (3).

According to Nayantara Padhi, (11) *"Ethics are foundation of the TQM philosophy. Organizational ethics establish a business code of ethics that outlines guidelines that all employees are to adhere to in the performance of their work. TQM is built on a foundation of ethics, integrity and trust. It fosters openness, fairness and sincerity and allows involvement by everyone. This is the key to unlocking the ultimate potential of TQM."*

Ethics play a critical role in the successful application of total quality. Ethical behavior on part of the organization is equally important for example include; honoring warranties, employee treatment, pollution, etc.
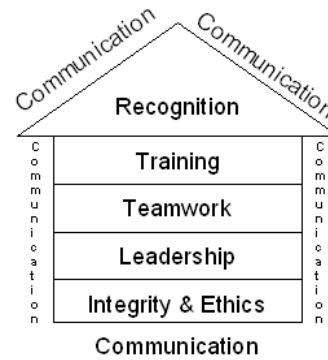
Fig-1 illustrates the basic 8 elements of TQM (11)

Trust and Quality

Ethical behavior builds trust, and trust is an essential ingredient in total quality. The various elements of total quality depend on trust like: communication, interpersonal relationship, conflict management, problem solving, teamwork, employee involvement, empowerment, and customer focus (8).

Value and Quality

Values are those deeply held beliefs that form the very core of any person and even organization. A person's conscience or internal barometer is based on his values and this guides his behavior. This is true for organizations as well. An organization will not produce quality produce or service unless the organization values quality.

Ethical behavior begins with values. Values that lead to ethical behavior include fairness, dependability, integrity, honesty and truthfulness. Values that lead to peak performance and excellence include achievement, contribution, self-development, creativity, synergy, quality and opportunity (8).

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Integrity and Quality

Integrity, as a personal and organizational characteristic, combines honesty and dependability. When there is integrity, ethical behavior automatically follows. Integrity is more than just honesty. People and organization with integrity can be counted to do the right thing, do things right, accomplish tasks thoroughly and completely, complete work on time, and keep promises (8).

Responsibility and Quality

Part of ethical behavior is accepting responsibility. It is important to the today world litigious society that, as a rule, shuns responsibility. People want to blame others for their own shortcomings and failures. Passing blame has become commonplace. And this is not ethical. In a total quality setting people are responsible for their actions and accountable for their performance. Accepting responsibility helps build trust and integrity. (8)

Ethics Implementation for Quality

Implementation of ethics is responsibility of organizations top management. Managers have 3 main responsibilities for setting an example of ethical behavior, helping employees make ethical choices and finally helping employees follow ethical behavior.

Managers can use three approaches to carry out their responsibilities. **Best Ratio approach** says that People are basically good, hence create appropriate conditions. **Black and White Approach** argues that Right is right, wrong is

wrong, hence make ethical decisions and carry them out **Full-Potential Approach** demands that People are responsible for realizing their full potential; hence decisions made should focus achieving this potential. (8).

Quality of Service in Telecom Industry

'Quality of Service' (QoS) is the main indicator of the performance of a telephone network and of the degree to which the network conforms to the stipulated norms (12). Telcos must keep improving their quality of service to retain their loyal customers and in order to increase their brand share and profitability (13). It is a known fact that long term customers spend more, refer new clients and are less costly to do business with.

It is claimed by Reichheld and Sasser (1990) that a 5% improvement in customer retention can cause an increase in profitability between 25% and 85% (in terms of net present value) depending upon the industry
The subscriber's perception of the QoS is determined by a number of performance factors, these are:

Mobile Network Performance, Reliability & Availability

We can determine quality of service of a mobile network by various parameters such as phone working & always available, making & receiving calls easily, getting clear voice quality of phone, less calls drops during conversation, less breakdowns/faults in phone. [13]

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Billing System

Accuracy of bill, Timeliness of bill to help plan payment and Clarity of bill are the key parameters for Telco's billing system [13]. We can quantify the efficiency of billing system by measuring billing complaints per 100 bills issued, period of billing complaint resolution, period of refund to customers.

Hidden Charges

Clarity of Bill, pre information of all charges to the customer, Taxes explanation should be considered the parameters for hidden charges.

Customer Services

Easy complaint registration process, quality of repair service, Operator promptness and behavior of operators are key parameters to determine customer service competence. [13]

Marketing and Advertising Campaigns

Accuracy of information, clarity of message in advertisements and simplicity and conformance to local cultural values improves the brand image of the companies.

Privacy of Customer Information

Safety of customer's content is it shared with some authorities if so, does customer have knowledge about it. Does company share the customer information for various marketing campaigns? These are all the parameters that can question the ethics of a cellular company.

Service Provision

Ease of applying and time taken to get phone improves the quality of service of a mobile company. Customers are much delighted with the companies whose processes are simple and non bureaucratic. (13)

Unsolicited Calls

No. of complaints of obnoxious calls and message from customer, provision to block the unwanted callers can improve the service quality of a company.

Data Collection Method

For this research, we have designed two types of survey forms. One for the employees of the targeted telecom companies and other for the customers of these telecom companies

Employee Opinion

We have further divided the employees of telecom companies into higher management, customer services personals and field workers.

Customer Opinion

For the customer questionnaire, intended audience is all the general public who are using the telecom services, ranging in different age groups, gender, and professions.

Data Collection

For our research 80 people responded of which 50 people from the telecom companies and 30 persons as their customers.
Amongst the 50 employees of the telecom companied 10 were higher

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managers, 25 were customer service representative and 15 were field workers.

Research Limitations

Primary focus is Pakistan telecom industry, so all the research work will be limited to the northern region of Pakistan including the Capital city only.

Survey Results

Customer Response

Information security

Below graph shows the customers response about their concern about their privacy and information security.
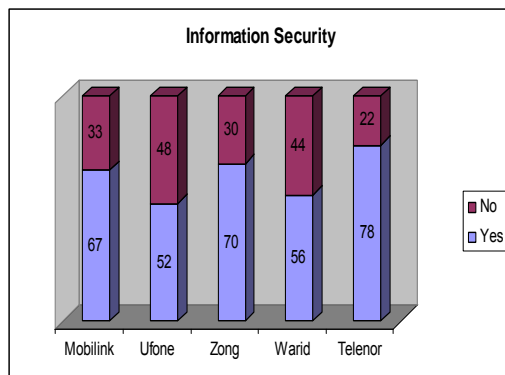
The graph depicts that majority of the customers are concerned about the security of their informational details.

Hidden Charges

The following graph shows the customers response about the hidden charges on various packages by these mobile companies.
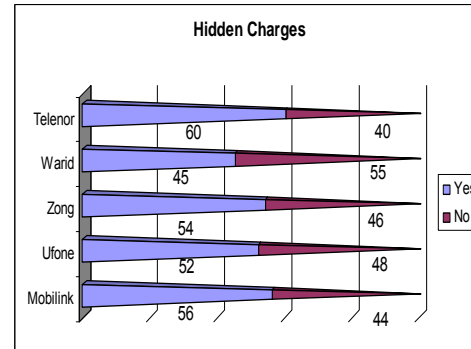
The graph clearly depicts that about 50% of the customers are ignorant of the hidden charges they pay.

Customer Service
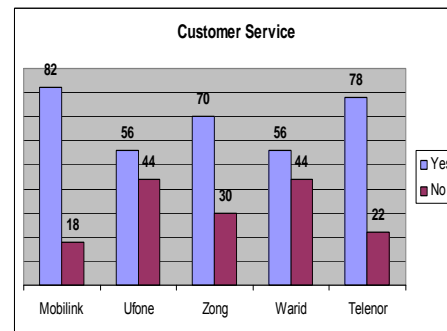
The graph clearly depicts that only the leading telecom companies are the ones which have better customer service solutions, for their customers.

Service preference parameters
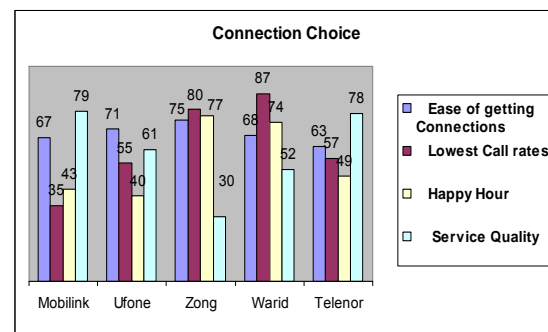
This graph has distinctively shown that apart from affordable mobile charges being a factor, companies chose the leading companies mainly due to the quality of service they provide.

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Unsolicited Calls

Following graph shows that customers view point on this issue.
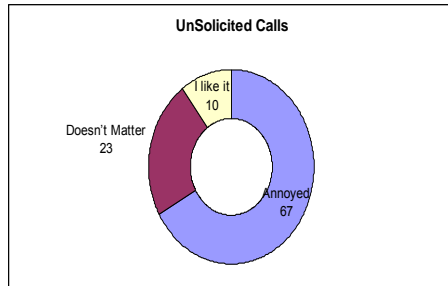
This graph shows that 67% customers are annoyed by unsolicited calls, while 23% are not bothered but 10 % of the customers like receiving unsolicited calls

Employees Response

Ethical practices in companies

Below graph presents how much telecom companies value ethical practices.
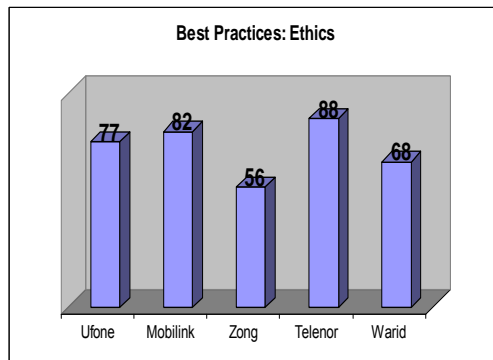
Implementation of Ethical Practices

Following graph shows which ethical components are more followed by the telecom companies.
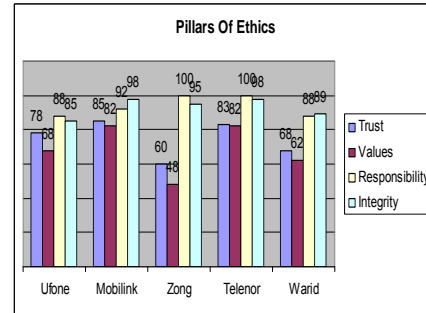
Decision Making Approach
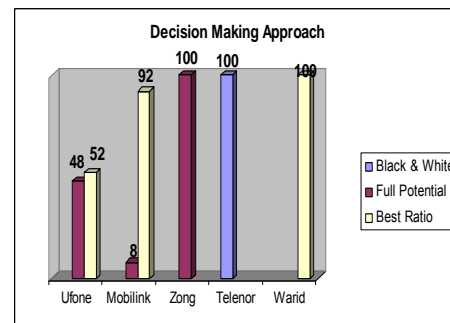
Data Analysis and Findings

Our survey results show that general customers are concerned about their privacy and security of content they are sending over mobile networks. Wrong billing is common. [10] Customers have complaints regarding their bills and unawareness about hidden charges.

Call dropouts are a problem for the cellular phone customers, calls doesn't connect at peak hours.

Customers are not happy about obnoxious calls and promotional SMS, The Pakistan Telecommunication Authority cites that complaints related to obnoxious calls and spam SMS continued unabated. The mobile companies had been asked by the authority to warn their subscribers and in some cases block the numbers. Most of

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these calls originated from unregistered Sims. (6)

Almost all of the telecom companies have defined a code of conduct for their employees, which bound them to act properly for the sheer interest of the customer.

Survey results show that companies believe in integrity and take responsibility of their actions. Most companies take decision in the best interest of company and employee rather than considering right and wrong.

Being Ethical pays rewards:
Our study shows that being ethical pays rewards, if a company has defined good ethical practices, it has better processes, customer is satisfied, and at the end company earns huge bucks.

Ethics & Competitive Advantage

Companies with good ethical practices have competitive advantage over their competitors; due to the fact that good ethical practices in place yield productive employees and which result in productive processes that results in increased customer satisfaction providing the competitive advantage.

Impact of Ethics on Employee Performance

When sound ethical practices are in place, they inculcate the sense of responsibility among employees resulting in full ownership of company values by employees; a relationship of trust and loyalty seeds between the employer and employee, increase the employee satisfaction level, thus results

in enhancement of employee performance and productivity.

Impact of Ethics on Quality of Service

Ethical practices improve all the key parameters of Quality of service mentioned above.

Impact of Ethics on Overall Business Growth

Ethical practices result in contented employees, delighted customers and this result in overall business growth and profitability.

Recommendations

It is important for cellular mobile companies in Pakistan to confine themselves strictly with ethical practices to improve their quality of service. Action needed by telecom companies can be summarized as (not in priority order)
1. Companies should make their new connection processes customer friendly.
2. Customer should be pre informed about all the liabilities hence knowledge about all the taxes and service charges.
3. Companies should take permission from customer before sending any promotional messages and ads to him.
4. Customer information should not be shared with any third party.
5. Companies billing processes should be improved.
6. All the complaints regarding billing should be handled as soon as possible.

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7. Customer service and marketing staff should provide proper information about different packages offered by the companies.
8. Advertising campaigns should be made considering the cultural norms of the country
9. Customers should have provision to block unwanted numbers
10. Companies must define a code of conduct and follow it properly
11. Top management should show their commitment to improve ethical practices of the company
12. Top management should set self example of ethical decision
13. Companies should improve and enhance their network infrastructure to improve their service quality.
14. Companies should train their staff about importance of ethics and their values in life
15. Companies should introduce some reward for the employees who perform ethically.
16. Companies should registered all the SIMS its customers are using
17. Companies should enhance their networks for the peak hour terrific to avoid customer's frustration.
18. Customer Service dept. should be trained to handle customer's complaints more effectively.

Conclusion

Ethics are foundation of quality practices; Pakistani telecom companies that have implemented good ethical practices have more well defined processes, their customers are happy, and they are making profits. Companies can improve their quality of service, productivity and profitability by implementing good ethical practices in their organizations. A firm commitment is required by the top management to promote ethics with in organizations. This study has shown that companies who have more strong ethical practices are able to retain their customer and also able to grab new customers as well.

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Organizational service orientation and its role in service performance formation; evidence from Polish service sectors

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Abstract

Purpose: There is an attempt to evaluate the state of organizational service orientation in service industry in Poland; also the influence of service orientation on key service performance, especially the quality of service, is examined. The cross-sector approach is employed and the problem of the differences of the organizational service orientation in different service trades is assessed.

Methodology: I the research process the survey method was employed. The research population enclosed 230 service enterprises operating in the three regions of Poland, the units were chosen randomly. The Serv*Or questions battery designed by Lytle et al. (1998) was employed to assess the organizational service orientation. There were taken the advantage of correlations analyses and ANOVA.

Findings: The weakest element regarding organizational service orientation in researched organizations is employee empowerment, which origins partly from national inclination to individualism, and partly from the central planning system that existed in Polish economy in communism age. The main conclusion of this study is that organizational service orientation affects service performance. Its influence on service quality and clients loyalty is substantial; therefore the organizational service orientation concept might be used as a useful tool in management process.

It is not proved that general indicator of organizational service orientation varied in service sectors. But it is possible to point out five service orientation dimensions that differ across sectors: customer treatment, employee empowerment, service standards communication, service vision, service training. There are two main factors that in an appreciable way differ the service orientation between service sectors: the structural factor and the service characteristics factor.

Originality of paper: The study takes cross-sector approach. Wide cross-sector studies did not used before in an organizational service orientation investigation.

Keywords: service management, service quality, service enterprises' development, organizational service orientation.

Paper type: research paper.

Introduction

Researchers, consultants and managers are still looking for better and better methods for the improvement of organizations. In this context there is an important role of searching organizational predicates of excellent organization outcome and enterprises' assessment of their ability to provide excellent products. Among economy sectors the service industry plays an

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increasingly important role. Especially a customer service is taking on an ever increasing level of importance in today's global economy (Baydoun et al., 2001:605). And after many years of continuous growth of service industry, there is still the need of efficient management techniques and organization assessment tools.

Service providing process, with its characteristics, needs particular management methods. There is a direct contact with a customer, and a service product must be provided well at the first time, and there is no space to failures. The service organization must be prepared very well to provide excellent service. Thus managers want methods for organizations ability assessments, the ability to provide excellent services. That is why the organizational service orientation concept was chosen for examination in this study.

The author of this paper elaborates on the problem of organizational service orientation and relational concepts. Also there is the attempt to evaluate the state of service orientation in service industry in Poland. The cross-sector approach is employed and the problem of the differences in the organizational service orientation in different service trades is examined.

Organizational service orientation

In the stream of different concepts which try to assess an organization's ability to provide excellent outcome there is the idea of organizational service orientation; it is not widely known among practitioners. Organizational service orientation describes staff attitudes and behaviours which directly affect the quality of service delivery process in a service organization and determine the state of all interactions between an organization and its customers. An organizational service orientation is defined by Lytle et al. (1998:459) as an organization-wide embracement of a basic set of relatively enduring organizational policies, practices and procedures intended to support and reward service-giving behaviours that create and deliver "service excellence".

The service orientation stays in the strong relationship with intangible aspects of an organization. It exists when the organizational climate for service crafts, nurtures, and rewards service practices and behaviours known to meet customer needs (Lynn et al., 2000:282). It also has been taken as something that manifests itself in the attitudes as well as actions of members of an organisation which highly values the creation and delivery of an excellent service (Yoon et al., 2007:374).

According to Lytle et al. (1998) an organizational service orientation consists of ten fundamental elements, which were led out from the best-in-class service practices and procedures. These elements (dimensions) are grouped into four service orientation attributes. These attributes and dimensions are as followed: service leadership practices (servant leadership, service vision), service encounter practices (customer treatment, employee empowerment), service systems practices (service failure prevention and recovery, service technology, service standards communication), human resource management practices (service training, service rewards).

Organizational service orientation plays an important role in a service enterprise. There are researchers' opinions as well as empirical examinations that acknowledged this. According to some authors organizational service orientation plays a crucial role in success of enterprises (Homburg et al., 2002; Walker, 2007). Service orientation is positively related to the main service delivery characteristics and business performance as well. Empirical investigations show the important influence service orientation on such variables as: service quality image, organizational commitment, profitability (ROA) in a banking sector (Lytle and Timmerman, 2006).

It is conceivable that the aspects described by this concept would have a substantial impact on organisation–customer interactions as well as the nature and quality of service delivery (Yoon et al., 2007). Service orientation was also identified as a "common denominator" of educational service attributes that are responsible for clients' satisfaction (Walker, 2007). Nevertheless, in a telecommunications call centre the organizational service orientation was identified as a factor that had no influence on service quality, whereas other service climate elements had a significant influence (Little and Dean, 2006). Service orientation is related to business performance characteristic such as re-patronage intention and positive word of mouth, with mediating role of staff satisfaction, service value, and customer, whose relationship was demonstrated in the medical service industry (Yoon et al., 2007). But on the other hand, service climate, which is a very similar concept, has been identified as negatively related to the owners service values (the degree to which owners valued innovativeness, attentiveness, outcome-orientation, aggressiveness, support, and decisiveness) in the small business environment (Andrews and Rogelberg, 2001).

According to Gonzalez and Garazo (2006) the organizational service orientation has a positive influence on employees' satisfaction and organizational citizenship behaviour. Organizational citizenship behaviour was defined as three main variables: (1) whether employees act as representatives of the firm to outsiders, (2) contact-staff participation consists in providing information about customer needs and suggesting improvements in service delivery process, and (3) following company regulations in such conscientious manner that they are adapted to the individual customer needs (Gonzalez and Garazo, 2006). In brief, organizational citizenship behaviour means "go the extra mile" for customers. These are very important elements of an excellent service delivery.

The approach of organizational service orientation is also used in the public services environment. Akesson et al. (2008) proposed areas of service orientation in public e-government services, their theoretical analyses show that this concept provides useful contribution to this particular services as well.

Despite many evidences showing a positive role of an organizational service orientation in service organizations, there are also exceptions. And examining the role of this concept in service quality still seems to be an interesting research question.

Organizational service orientation vs. similar concepts

Some authors mention that generally there are two important factors influencing employees' tendencies to provide the quality of service: the first one lays in the organization of a service company, and the second exists in individual personality characteristics (Baydoun et al., 2001; Homburg et al. 2002). The former is described by "macro-organizational approaches", like service climate and service orientation. The latter is personality-based approach and it is focused on the personal skills and other features of the staff assessed by psychological tests and other similar tools. "Customer service orientation" is mostly analysed in service management as a personality-based description of the service phenomenon.

Organizational service orientation is often described in the context of service organization climate (Lytle and Timmerman, 2006; Lynn et al., 2000; Lytle et al., 1998). Organizational climate and culture are interconnected. Employees' values and beliefs (part of culture) influence their interpretations of organizational policies, practices, and procedures (climate) (Schneider, 1996:9). The organizational climate includes employees' perceptions of the policies, practices, and procedures that are rewarded, supported, and expected concerning clients (Schneider et al., 2002). The climate of an organization is a summary impression employees have about "how we

do things around here" or "what we focus on around here" or "what we direct our efforts to around here" (Schneider et al., 2006:117). The climate is a psychological identity of employees in an organization. A climate is researched in the service environment context, thus it is called service climate (Schneider, 1980; Schneider et al., 2006; Steinke, 2008; Little and Dean, 2006; Walker, 2007).

It is also noticed that customer service orientation concept is in many ways similar to the organizational service orientation but it is focused on staff behaviours and more psychological interpretation. Customer service orientation is specified by interpersonal skills, extroversion, and general disposition of operators having positive influence on the operators' performance (Alge et al., 2002). It is still perceived as a part of the service climate. Walker (2007) classifies three service climate dimensions as "service orientation"; they are: staff service ethos, staff personal attributes, and staff concern for clients. They were found as key elements of organizational service climate. Little and Dean (2006) also classify customer service orientation as a dimension of service climate. They propose four dimensions of service climate and one of them is the customer orientation, and it is understood as a degree to which an organisation tends to meet customer needs and expectations for service quality.

Baydoun et al. (2001) propose instruments for customer service orientation assessment. It demonstrates the utility of personality variables for predicting service behaviour. Basing on this instrument the high-quality service providers could be selected. There are more methods for customer service orientation assessment. Martin and Fraser (2002) use the Customer Service Skills Inventory for identifying individuals who are likely to succeed in positions that involve working with customers or clients of an organization. The CSSI is a short self report measure of customer service orientation designed by Sanchez and Fraser (1996).

The literature provides also the "customer orientation" concept derived from a relationship marketing approach. The customer orientation concerns service employees who have a direct contact with customers. Hennig-Thurau and Thurau (2003) proposes customer orientation as a three-dimensional construct: employee's motivation to serve customers, their customer-oriented skills, and self-perceived decision-making authority.

Finally it is considered that organizational service orientation is a part of a wider concept of organization's overall climate. And it is necessary to admit that the organizational service orientation construct is not clearly defined (Lytle et al., 1998). But it seems to be very important from the point of view of service firms' business development. It mostly concerns an inside organizational system which is created by managers and it provides relatively precisely defined field to organizational changes and improvement which aims at the service excellence. It also might be useful in monitoring purposes, and in a benchmarking process as well.

Organizational service orientation measurement

Organizational service orientation was measured by researchers in many service industries; they used several measurement tools to identify the state of service orientation. For example researches (Andaleeb et al., 2007) used the specific survey tool to approximate the doctors' service orientation, but in this case the concept of service orientation was understood as a set of doctors' behaviours towards their patients. The established construct of service orientation was more similar to the customer service orientation mentioned above.

A very useful tool for organizational service orientation measurement was proposed by Lytle et al. (1998), and it was named "Serv*Or". Serv*Or consists of 35 question items with Likert's scale. The questionnaire items describe four attributes of organizational service orientation, these attributes altogether comprise 10 organizational service orientation dimensions. The attributes

and dimensions of Serv*Or were presented in the second paragraph. The tool was tested and validated in American banking sector and retailing building suppliers. According to the authors the Serv*Or tool demonstrates a cross-industry universal instrument for assessing service orientation in other firms, not just banks (Lytle et al., 1998). The authors of the instrument mention that it can be used across different industries and different work environments as well, for service orientation diagnosing.

The Serv*Or tool was successfully used, inter alia, in the hospitality industry (Gonzalez and Garazo, 2006), medical services (Yoon et al., 2007) banking sector (Lynn et al., 2000; Lytle et al., 1998) and among retail building suppliers (Lytle et al., 1998). Some authors also revised and proposed a modification to the Serv*Or scale, Lee et al. (2001) did this in a case of hotel industry in Korea.

Aims, method and the research sample

The proposed investigation process tries to prove whether the organizational service orientation is really a predicator of service key performance in the wide scope of services organization from different trades. The organizational service orientation construct can be treated as a part of organizational culture, where national specific aspects play a significant role. Thus it seems to be also interesting to investigate the role of service orientation in the economy background of a post communist country from Central Europe.

The study takes the cross-trade approach. It is known that services across different sectors have a different nature; depending on how close servants are to customers, if the use of standardization is wide or not, what the roles of capital and human power are, etc. Therefore, it is worth identifying which aspects of organizational service orientation are different across the different types of service organizations. It can bring the conclusions with reference to the role of service orientation dimensions across service sectors - which of them are equal in different service sectors and which are different in the definite way. The suggestions concerning the service orientation dimensions can be drawn.

The Serv*Or tool (Lytle et al., 1998) was employed, and a few significant service enterprises performance characteristics were gathered as well. Service orientation is treated as the independent variable, and service outcome as the dependent variables. In studying the problem of differences of organizational service orientation in service sectors the variable "service trade" is considered as the grouping one for ANOVA.

The empirical investigation was conducted in three regions of Poland – Podlasie, Mazowsze and Warmia & Mazury. Poland joined EU in 2004, the few years period of the adjustment programme had been established before. After the 1989 when the communistic system collapsed the Polish economy was changing rapidly, the preparation for EU joining was the strong improvement impulse for the Polish economy. Polish GDP increased more than 5.5% yearly in the last years and there are optimistic forecasts to keep at list the same growth [Wiegert, 2007]. Service sector is growing rapidly, providing 64.5% of GDP in 2005 [The economy, 2007]. In fact, it is not huge services participation in comparison with other developed countries, but the service industry has great dynamics.

A single enterprise was the research unit, the inquiries were addressed to a manager (or owner if he/she attends managerial role) from an enterprise. Gonzalez and Garazo (2006) also interviewed managers in organizational service orientation identification process. The research population enclosed 230 service enterprises operating in the three regions of Poland mentioned above, the units were chosen randomly. Instructed researchers visited managers in enterprises and asked them questions based on the questionnaire. The Serv*Or questions battery was translated and

modified, some of them were combined together, all these in purpose of being clearly understood by respondents. After the preoperational free interviews it was decided to employ the scale 1-5, which seemed to be better for respondents than seven gradual. For most service performance variables identification the managerial assessment was used.

All main sectors of the service industry were represented in the research sample (according to EU classification 24 sectors were detached specially for this study). Sectors were not represented equally, the largest one that appeared in the sample was the construction and building renovation sector (24 objects) and the smallest - R&D services (only one object) and mineral resources exploitation services (also one object). In the research sample there were mostly small and medium enterprises, those with less than 250 employees constituted 91.5% of the sample.

Organizational service orientation in the research sample

Organizational service orientation shows organization capability to provide excellent service to their customers. According to the research the average score of service orientation comes to 3.56 in the 5 points scale. The statistics are shown in Table I. Going deeply into dimensions and attributes it is noticeable that "service leadership practices" are the best aspect of service orientation of researched enterprises. This attribute contains strong vision of a service and stressed role of customers among managers and service staff, managers' personal involvement in service providing process as well. A very interesting state is recognised in the attribute "service encounter practice". On one hand, there is the one of the most scored variables – "customer treatment", and on the other hand, the second component "employee empowerment" which is the least scored (with the highest standard deviation). This observation may be explained by the managerial attitudes specific for the country where the research was conducted. Managers in Poland, the country with central planning system heritage, still prefer to focus on an individual, they consider management success as a single person achievement, rather than a team success.

Table I. Serv*Or score

	Mean	SD
Customer treatment	4.06	0.725
Employee empowerment	2.99	1.296
Service encounter practices	3.50	0.907
Service technology	3.61	1.105
Service failure prevention	3.71	1.031
Service failure recovery	3.41	1.039
Service standards communication	3,39	0,963
Service systems practices	3.46	0.826
Service vision	4.12	1.021
Servant leadership	4.00	1.140
Service leadership practices	4.02	0.960
Service rewards	3.11	1.117
Service training	3.39	1.240
Human resource management practices	3.22	1.062
Organizational service orientation	**3.56**	**0.714**

Organizational service orientation and service performance

In the questionnaire there were items related to the main organization performance. The overall service quality level was identified; the changes in enterprises' market share, the changes in profitability, clients' satisfaction and clients' loyalty were identified as well. The correlation coefficients were counted between all service orientation attributes and also a global score of service climate and all performance variables (Table II).

Table II. Correlations between studied variables

	Quality level		Market share		Profitability		Clients' satisfaction		Clients' loyalty	
	Gamma	p-value	Gamma	p-value	Gamma	p-value	Gamma	p-value	Gamma	p-value
Service encounter practices	0,263	0.000016	ns	-	ns	-	ns	-	0.151	0.006285
Service systems practices	0.245	0.000048	0.142	0.011472	0.141	0.010637	0.173	0.002118	0.178	0.001184
Service leadership practices	0.216	0.000952	ns	-	0.163	0.006376	0.271	0.000008	0.237	0.000063
Human resource management practices	0.308	0.000000	0.189	0.000889	0.231	0.000037	0.203	0.000368	0.196	0.000417
Service orientation	0.331	0.000000	0.169	0.002644	0.220	0.000068	0.243	0.000016	0.256	0.000003
ns – non-significant										

There is a significant relationship between organizational service orientation attributes and majority of service performance variables. The most important one is the influence of service orientation on service quality, all service orientation attributes have significant correlations. It proves that the service orientation is a really important predicator of service quality performance. So, it could be considered that service orientation construct is a pretty good measure which can assess the ability of a service organization to provide an excellent service. Taking into consideration that many service sectors were examined it allows to suggest that Serv*Or could be the universal cross-sector test.

The next performance variable which in a significant way is affected by service orientation is clients' loyalty. The correlation coefficients are significant with all service orientation attributes. And it is not surprising that there is an attribute (service encounter practices) that is correlated to the loyalty and not correlated to clients' satisfaction. Satisfaction might be the main loyalty predicator but not often (Oliver, 1999), nevertheless loyalty seems to be one of the most important organizational performance components (Reichheld and Teal, 2001). Further service performance correlations also proved the important role of the organizational service orientation.

The differences between sectors

There were 25 categories in the variable "service trade", one of them was "others". It was decided to employ the ANOVA to investigate if there are significant differences between service orientation score in service sectors. Sectors were not represented equally, and some of them included little items, therefore the service sectors including less than five items were rejected from the sample. A one-way ANOVA provides results shown in Table III.

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Table III. ANOVA results

	F-statistic	p-value
Customer treatment	2.764	0.000285
Employee empowerment	2.252	0.003528
Service encounter practices	1.930	0.015465
Service technology	ns	-
Service failure prevention	ns	-
Service failure recovery	ns	-
Service standards communication	1.756	0.033087
Service systems practices	ns	-
Service vision	2.171	0.005134
Servant leadership	ns	-
Service leadership practices	ns	-
Service rewards	ns	-
Service training	2.227	0.003945
Human resource management practices	ns	-
Organizational service orientation	**ns**	**-**
ns – non-significant		

Taking into consideration variances in different service sectors there is not a significant difference in the global service orientation score. But some particular service orientation dimensions vary in sectors. The largest diversity is noticed within "service encounter practice". Service encounter is probably the most important thing that diversifies service orientation across sectors. The most remote contact with clients does not require superior organizational service orientation. This concerns also services provided to business clients. Unfortunately service sectors were separated using as a base the Statistical Classification of Economic Activities in the European Community (NACE) which does not allow a clear isolation of B2B and B2C services.

For more detailed conclusion related to the climate differentials in service sectors the Fisher's LSD (Least Significant Difference) procedure should be applied. It allows investigating the individual differences between particular variables in pairs of sectors. But in this case it is rather complicated to trace it in details because of the great number of pairs (pairs of sectors and few service orientation attributes).

Using Statistica software the LSD significances were counted for five service orientation dimensions, those for which simple analysis of variance has shown the significant differences: customer treatment, employee empowerment, service standards communication, service vision, service training. For each service sector the numbers of significant pairs were summed up together. In the five service orientation dimensions mentioned above the greatest number of significant pairs of service sectors were identified in "telecommunication and post services" – altogether 29 pairs, next one was "construction and renovation services" – altogether 26 pairs, next "vehicle services and petrol retailing" – 19 pairs.

Telecommunication and post services are specific, there are still state monopolies in a few kinds of service, in phone calls services there are only a few really strong market players. In most European countries these services often lead customers to complaint making. The sector structure, remains from previous years, and rather remote contact of service staff with customers drive specific organizational service orientation.

Construction and renovation service sector provides services with rather low personal contact. Most of researched firms provide services as a subcontractor in huge building-states. Taking care of customer and service quality little relay upon the personal interactions, but rather it lies in manual solid work and technical support. Vehicle repairing and petrol retailing sector also is

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characterised by a strong role of service equipment and manual cleverness. It is probable that service features affected the state of organizational service orientation.

Final conclusions

The data shows that in organizational service orientation in researched organizations the weakest element is employee empowerment, which origins partly from national inclination to individualism, and partly from the central planning system that existed in Polish economy in communism age. The high score of dimension "customer treatment" proves that the firms have adapted to the market orientation.

The main conclusion of this study is the fact that organizational service orientation affects service performance. Its influence on service quality and clients loyalty is substantial, thanks to this, service orientation might be used in a management process as a concept for service organization assessment. Moreover, it provides a great framework to service organization improvement. The concepts of organizational culture or climate might discourage managers by so many intangible elements difficult for direct observation. And it might be the advantage of the Serv*Or instrument that it does not measure the values and beliefs, but it is only focused on practices within the organization. Thanks to this, it is more universal, and it has a potential for use in specific cultures and variety of nations.

The study takes cross-sector approach, thus the diversity between service sectors might be investigated. Wide cross-sector studies are rather a seldom practice in the quality management field, and in this study it was a challenging problem. Despite the fact it was not proved that general indicator of service orientation varied in sectors, it is possible to point out five service orientation dimensions that differ across sectors: customer treatment, employee empowerment, service standards communication, service vision, service training.

There are two important factors that in an appreciable way differ the service orientation between service sectors: first one, let us call it "structural factor", it relays upon the fact that an organizational service orientation is affected by the structure of a sector; the second one comes from the service providing process characteristics, especially closeness to customers.

Limitations of this study may be found in the fact that the respondents in the researched enterprises were only managers. Their points of view might be different from those of all the staff who are employed in enterprises.

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PRODUCT COMPLEXITY REDUCTION
– NOT ONLY A STRATEGY ISSUE

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ABSTRACT

Introduction: Nowadays many industrial organisations are dealing with more and more complex products to comply with customer demands. This has the positive effects of increasing the market share and enabling manufacturers to enforce higher product prices. However, increased product complexity comprises some drawbacks as well. Most important to mention are increased product cost but also quality problems and prolonged lead times (Galsworth, 1994). Due to those drawbacks there have been made several attempts to reduce product complexity which were more or less successful (Bohne, 1998; Bliss, 2000). However, nowhere it is mentioned that to enable successful product complexity reduction an according organisational culture has to be developed. That is, to be able to implement an innovative product complexity reduction strategy it is important to create a company culture which fits and supports this strategy. If these two issues are in line with each other the chances for realising this strategy are maximised. Therefore, this paper combines classic approaches of product complexity reduction with the cultural aspects necessary inside the organisation to be successful. The result is a comprehensive guideline for fruitful product complexity reduction efforts.

Purpose: It shall be shown how plans and strategies for product complexity reduction can be derived by analysing the actual product structure. Further, it should be pointed out which kind of organisational culture is necessary to realise these strategies. By doing so, a guideline for product complexity reduction will be created including plans for product complexity reduction efforts as well as how an appropriate and supporting company culture should look like. The result is a comprehensive guideline for successful product complexity reduction efforts.

Research method: In this conceptual paper a method is introduced to analyse the actual product structure according to necessary product complexity which is creating customer benefits and the non-necessary product complexity which is not directly linked to increased customer benefits. Based on this analysis plans and strategies can be derived to reduce non-necessary product complexity. Finally, it will be illustrated that a specific organisational culture is needed to reduce product complexity in a meaningful way.

Results/conclusions: Analysing the product structure according to necessary and non-necessary product complexity enables an organisation to develop strategies and plans to reduce product complexity while at the same time keeping customer benefits constant. To be able to divide product complexity into necessary and non-necessary complexity an understanding has to be developed how product complexity is creating customer benefits and what the impacts of product complexity throughout the organisation are. That is, a broad integrated approach is necessary to gather this information. Therefore a cross functional or system focused organisational culture is necessary.

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INTRODUCTION

Product complexity regarded from two perspectives. On the one hand it is necessary to fulfil the requirements of a complex market (Bohne, 1998). That is, if customers request an advanced product with a lot features and at the same time a high degree of product variety it is necessary to develop a complex product. This kind of product complexity is necessary to create a product which the customers value. On the other hand product complexity can be negative (Child, Diederichs et al., 1991; Bliss, 2000). This is the case when the degree of product complexity exceeds the degree of necessary complexity which is demanded by the market. In this situation unnecessary complexity is created without adding additional customer value. Nowadays products become more and more complex and several companies loose control over the degree of product complexity (Bliss, 2000). That is, the degree of product complexity does not orient towards the complexity which is demanded by the market any longer, moreover, without an identifiable reason it is growing unintentionally. To be able to assess whether one is dealing with necessary or unnecessary product complexity it is essential to be able to measure product complexity. When looking at the literature on product complexity one can observe that there have been several approaches undertaken to measure product complexity (Benton and Srivastava, 1993), (Guide, Srivastava et al., 1997), (Sum, Oon-Sen Png et al., 1993). The measures of product complexity are used to research the impacts of product complexity on e.g. lot sizing, inventory stock levels or production process complexity. The general notion is that the less product complexity is created the better it is for the organization's operations. This is supported by empirical evidence e.g. Sum, Oon-Sen Png et al.(1993) showed that less product complexity results in lower inventory levels, less complex material flows and lower production costs.

Since product complexity is generally regarded as having negative impacts on the company's operations it should be reduced to the amount of necessary product complexity which is needed to fulfil market demands. However, it appears that some organisations loose control on the degree of product complexity. Therefore, the purpose of this paper is to investigate how the degree of product complexity could be controlled and kept at a reasonable level.

PRODUCT COMPLEXITY REVIEW AND FRAMEWORK

Product complexity is a widely used term and so far there is no generally accepted definition of it. This is expressed in the following citation. "Choice of measures of product complexity depends of the objectives of the analysis, the product and production system, and in some case, the accessibility of data."(Ding, Sun et al., 2007). This refers to the fact that many papers dealing with product complexity create their own, "customised" definition of product complexity. That is, product complexity can be researched according to its implications on lot sizing (Sum, Oon-Sen Png et al., 1993). Other authors researched the impacts of product complexity on the supply chain (Novak and Eppinger, 2001). Kotteaku, Laios et al. (1995) estimated the impacts of product complexity on the purchasing activities. All the above mentioned authors created their own customised product complexity definition. This paper differs from the mentioned examples in the following way. It is tried to develop a general description of product complexity to be able to offer a general product complexity reduction guideline. That is, this guideline should be applicable for different products in a various of industries.

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Product complexity in its context

  Before a more detailed description of product complexity is given product complexity has to be positioned in its context. That is, beside product complexity there are several other kinds of complexity in the production system? Bliss (2000) identified four different kinds of complexity. These are customer portfolio complexity, program complexity, product complexity and process complexity. The latter one, process complexity, can be further divided into production program complexity, organization complexity and complexity of the manufacturing system. All kinds of product complexity can be summarized under the term organizational complexity.

Putting product complexity into its context of organizational complexity with its different kinds of complexity illustrated by Bliss (2000) is not sufficient. What is missing are the relations of the different kinds of complexity to each other. This shortcoming is overcome by the introduction of the concept of the degree of coupling (Bohne, 1998). In this approach complexity in general is interpreted as multidimensional variety. Other than Bliss (2000) Bohne (1998) defines organizational complexity not as a set of different kinds of complexities but as as different kinds of varieties e.g. market and customer variety, material variety or process variety. Bohne (1998) connects the different kinds of variety (complexity) to each other according to their causal relationships. In other words, organization complexity is propagating through the organization. This chain of relationships begins with market and customer variety which leads to a high variety offering. This results in a high degree of material variety. To handle a high variety offering and high material variety process complexity (process variety) has to be increased. The final result is high resource variety and supplier variety. The chain of causal relationships is illustrated in figure 1. For the remaining part of the paper high variety offering and material variety is interpreted as product complexity. To underline this deviation from Bohne (1998) the two kinds of variety are shaded grey. This will also be the focus area in this paper. To enable further discussion two important issues have to be pointed out. Firstly, product complexity results from market and customer variety. Market and customer variety is an exogenous variable which imports complexity into an organization (Bliss, 2000). Since it is an exogenous variable this variety is regarded as fixed in the remainder of this paper. The second issue to point out is that several other kinds of complexity are a result of product complexity e.g. process, resource and supplier complexity, see figure 1. The concept of degree of coupling is basically
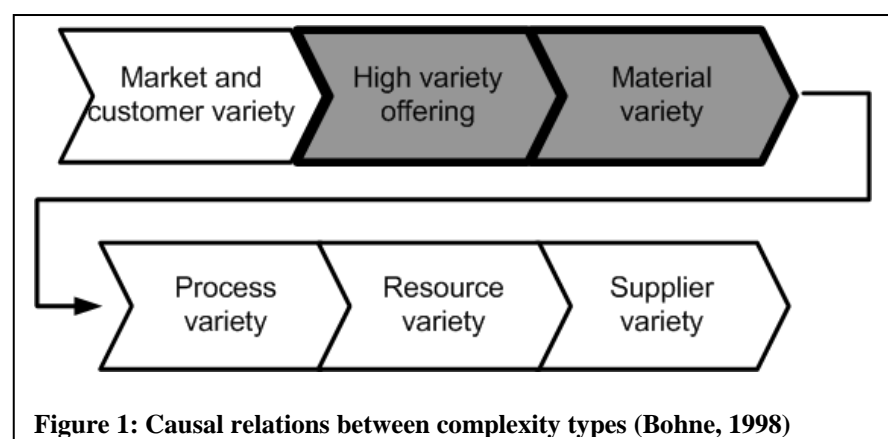
Figure 1: Causal relations between complexity types (Bohne, 1998)

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saying that the different kinds of variety are not coupled fully. That is, there are several possibilities to decrease the coupling between the different kinds of variety. This paper now addresses the interfaces which product complexity has towards the market and customer variety and the following kinds of variety, see figure 1. It will be pointed out that product complexity can be adapted to inhibit the total propagation of external market and customer variety throughout the whole organization. The underlying rationale for doing that is to reduce the overall organizational complexity.

Product complexity based on complexity dimensions

As described above there is a big amount of different definitions of product complexity and no generally accepted description. That means that the main challenge in the definition of product complexity will be to develop a generally applicable description of product complexity. Therefore, during the literature study the different concepts were scanned according to two criteria. First, the product complexity dimension had to be general and not only applicable to one product or one group of products. Second, the measures for product complexity had to be differentiated from measures of other kinds of complexity e.g. process complexity or resource complexity. The results of the literature review are shown in table I.

Product complexity dimension	Authors
no. of relations between elements	(Patzak, 1982); (Barclay and Dann, 2000); (Bliss, 2000; Novak and Eppinger, 2001)
type of relations between elements	(Patzak, 1982); (Barclay and Dann, 2000)
no. of elements/component/parts	(Patzak, 1982); (Barclay and Dann, 2000); (Novak and Eppinger, 2001);(Sum, Oon-Sen Png et al., 1993); (Guide, Srivastava et al., 1997)
type of elements	(Patzak, 1982)
no. of technologies involved	(Barclay and Dann, 2000)
product breadth/no. of product variants	(Benton and Srivastava, 1993); (Ding, Sun et al., 2007)
extent of embedded software	(Hobday, 1998)
model mix complexity	(MacDuffie, Sethuraman et al., 1996)
parts complexity	(MacDuffie, Sethuraman et al., 1996)
option content	(MacDuffie, Sethuraman et al., 1996)
option variability	(MacDuffie, Sethuraman et al., 1996)
no. of attribute	(Ding, Sun et al., 2007)
no. of attribute values	(Ding, Sun et al., 2007)
no. of unique parts per attribute	(Ding, Sun et al., 2007)
no. of moving parts	(Banker, Datar et al., 1990)

Table I: Product complexity dimensions

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Product complexity as a relative element

The following question to be answered is how to apply these product complexity measures. When addressing this question two things have to be kept in mind. First, they have to be measured and displayed in a way that they work as a guideline e.g. for product development engineers and that they are generally applicable. Coming to the latter one, different industries have different demands on their products. To take an easy example, what is high degree of product variants in the household appliances industry is probably totally different from a high degree of product variety in the car or truck industry. When comparing different industries with each other this argument seems to be straightforward. However, even in the same industry there are different market segments which vary in their inherent level of product complexity. To sum up, a general accepted definition of product complexity appears to be difficult since it is almost impossible to put absolute values on the different product complexity dimensions which are valid for several different products. To face this problem product complexity can be regarded as a relative element (Guide, Srivastava et al., 1997), (Suh, 2005). Before doing this the difference between "necessary" and "non-necessary" complexity is explained further. According to Bliss (2000) product complexity is partly regarded positive (necessary complexity). That is, to be able to correspond to markets demanding a highly advanced product with several variants which can be customised a complex product has to be developed. In other words, in order to create customer value an according degree of product complexity is necessary. External and internal complexity have to match each other. However, Bliss (2000) further argues that product complexity is also created without creating customer value (non-necessary complexity). These coherences are shown in figure 2. The important implication is that market and customer variety demand internal variety (necessary complexity). However, beside the necessary complexity also non-necessary complexity is created. The important point is that necessary and non-necessary complexity with all its negative impacts influence increase the complexity in other organizational units.

THE CASE COMPANY

The data for this paper has been collected as part of a three-year longitudinal and in-depth research study in a European manufacturing company. Their product development activities are mainly located in Europe, however, this organization has

Figure 2: Necessary versus non-necessary product complexity

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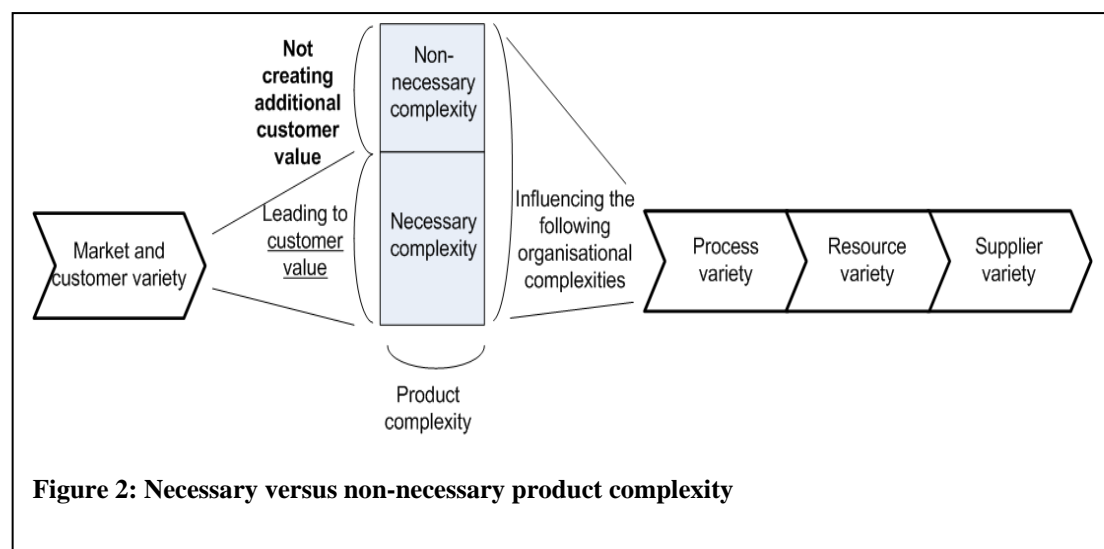
production facilities all over the world. This longitudinal research study began approximately one and a half years ago, during this time the data has been collected on a regular basis. The reason for conducting this study was to reduce the organizational complexity by introducing a revised platform strategy and modularising the product stronger. Due to the complexity reduction focus of the study and the fact that the product is complex the study offered the opportunity to apply the concept of relative complexity. Further, the product fulfils many of the product complexity dimensions identified in this paper, e.g. it consists of a large number of parts and there are many connections between these parts in the product.

The chosen area of analysis

Investigating the whole product in terms of one, several or all product complexity dimensions would be much too time consuming. Instead, the study focused on the interfaces between the three biggest and most complex units of the product. Firstly, there is the base module and secondly two big modules. Finally, these two units have to be assembled on the base module. That is, we are dealing with two interfaces. Since these modules are complex units and comprise a rather large share of the product only the connecting media between these three modules was analyzed, that is, the number of interconnections. More precise, it was focused on the number of potential interface connection variants. Hereby, the connections which were supposed to have the most severe impact on other kinds of complexity throughout the organization were analyzed.

These were for the Base module – Module 1 interface:

- Fuel lines
- Water to power steering system
- Electrical signal
- Electrical ground
- Electrical power
- Hydraulics to power steering

And for the Base module – Module 2 interface:

- Pneumatics
- Clutch hydraulic
- Fuel
- Gear shift cable
- A/C pipe
- Water pipe
- Fuel hose
- Electrical signal
- Electrical ground
- Electrical power

The analysis was done as follows. Firstly, the actual product structure was mapped in terms of connections between the modules. For each connection the number of connection variants was determined. Than a realization of the revised platform and at

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the same time a stronger degree of modularity was assumed. Under this scenario it was assessed to which degree the amount of connection variants between these modules could be reduced.

ANALYSIS

In this paper the concept of relative complexity is applied to assess the potential of product complexity reduction. Further, an approach will be proposed which supports a successful product complexity reduction strategy.

Product complexity as a relative element

The idea of a relative complexity measure works as follows. First the actual value of one complexity dimensions in table I is determined (necessary and non-necessary complexity). Than an optimal product structure, which only creates customer value, is assumed. Subsequently the value for the chosen complexity dimension is assessed again in this ideal scenario. That is, how much complexity is necessary to create the expected customer value (only necessary complexity). Finally, necessary complexity and actual complexity are set into relation to each other:

Relative complexity = necessary complexity / overall complexity   (1)

A value below one would mean that there is more product complexity than which is necessary to create the expected customer value. The higher the value for relative complexity the lower is the amount of unnecessary product complexity which is not creating any customer value. If the value for relative complexity is one one is facing the ideal situation of no non-necessary complexity.

It has to be mentioned that the reduction potential of the media connection variety has been assessed based on the assumption that the customer value is not increased or decreased. That is, the difference in the number of media connection variants in the actual state and the in the optimised product state can be regarded as non value adding for the customer. The results of the data gathering are shown in the tables in appendix 1 and 2. The number of connection variants for each interface was added and applied to the above introduced equation 1.

$$relative\_complexity = \frac{necessary\_media}{acutal\_media}$$

$$= \frac{20 + 4 + 100 + 1 + 1 + 1 + 2 + 400 + 5 + 1}{65 + 20 + 500 + 2 + 280 + 4 + 3 + 10 + 800 + 10 + 200 + 20 + 30 + 110 + 7 + 20 + 40}$$

$$= \frac{535}{2121} = 0,252 \approx 25,2\%$$

In this example of the three modules the necessary product complexity in terms of number of connections variants between elements is 0,252 times as big as the actual product complexity. That is, only 25,2% of the product complexity in terms of connections between the elements is necessary to create the delivered customer value. The relative complexity measure provides a clear guideline towards product development to reduce the number of connections between the different modules by applying a higher degree of modularity.

This calculation can be done for several product complexity dimensions. This provides product developers with an accurate overview over the product structure,

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that is, how much of the complexity is actually creating customer value and how much complexity has been created unnecessarily.

The result is rather impressive and states very clearly what the actual situation with regards to product complexity is all about. Only 25,2 % of the product's complexity in terms of number of connection variants is necessary. How is it possible that an organization is so far away from the optimal status. Are there some mechanisms which lead to higher product complexity? In the case company e.g. business cases are applied for different kinds of product development decisions. These are applied in a way that they focus on a rather small part of the product and that only quantifiable impacts are considered. The result is that impacts of product development decisions in the rest of the product are not considered. Further only claearly quantifiable impacts are considered in the business cases while the costs of complexity are mostly hidden (Child, Diederichs et al., 1991). The result is that impacts of product complexity are not included in the business cases. This low system focus leads to an externalisation of cost. That is, product development decisions are made without considering all its consequences. As a result, product complexity grows. Another example is the high degree of functional differentiation with a low level of cross-functional communication at the same time. This further intensifies the problem of assessing the impacts of product development decisions in other functional units. It was also observed that overall targets were broken down in a way that two functional units with mutual task dependencies developed contradicting behaviors which inhibit the optimization of the overall goal.

If it's clearly shown that one is so far away from optimal situation one could assume that it is very easy to take the appropriate action, according to the expression:"Ok, we have a problem, let's do something about it!" However, it has to be made clear that this is not that easy. The right question to ask here is: Although all people involved in product design have been given their best over the last decades we did end up with this situation. What is the underlying reason? An answer to this is given by Schein (1985). He is stating that one has to understand the company culture to understand the mysterious and seemingly irrational things that are going on in human systems. That implies that a specific company culture leads to situations like this one. The other way round this means, if a mysterious or seemingly irrational organizational behaviour should be changed one has to include the culture. It is not a seldom phenomenon that companies fail to implement strategies which make sense from a financial or like in this case product point of view because the demanded company culture is too far out of line with the company's culture (Schein, 1985). This is in line with Martenssen and Dahlgaard (1999). Their concept of the extended PDSA loop shows this interconnection in between an intended strategy and a necessary culture to realise this strategy. The concept of the extended PDSA loop basically states that after a company has formulated its strategies and plans and discovers that it does not have the supporting company culture for realising these strategies the culture has to be adapted as well. Several authors agree that that strategies, to be implemented or already existent, need to be backed by an according culture (Deal and Kennedy, 1982; Kahn, 1996).

To sum up, it has been shown that the degree of product complexity is rather high in the case company. Further it has been argued that a newly introduced strategy demand a supporting cultures. The next step is to provide the necessary supporting culture to facilitate the realisation of product complexity reduction.
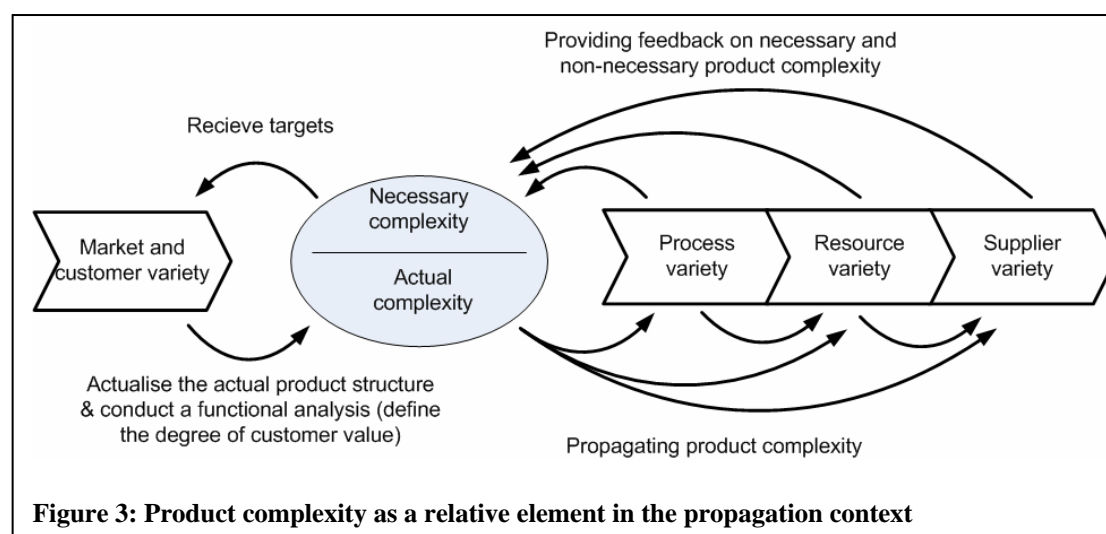
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System focused company culture

  When we are talking about a specific culture providing an appropriate environment for product complexity reduction we are entering a rather untouched field. Nevertheless, when looking at the underlying reasons of unnecessary complexity several characteristics of a potential environment come to the fore.

Further it has to be pointed out that product complexity is a result of the product development process (Banker, Datar et al., 1990). While this statement is rather straightforward it has important implications for the degree of product complexity. That is, the product developers decide upon the degree of product complexity. According to Bohne (1998) product developers are well aware of market demands. However, they are not fully aware of the cost and complexity implications of their design choices. Bohne (1998) has identified a transparency deficit regarding product complexity. That is, with nowadays accounting systems the real cost impacts of product complexity can not be traced. Accounting systems allocate product cost according to material cost and man hours. Further, they have a strong focus on the direct processes and therefore neglect the indirect processes. This leads to the following problems. Firstly, it is difficult to assess the complexity costs of design choices in the design stage. Consequently it is difficult to compare product complexity design choices. It can be summarised that the target system for product developers is open in terms of product complexity. Since nowadays accounting systems are not of much help for the product developers in assessing the implications of their design choices one can conclude that there are other means needed to make product developers aware of the implications of their design choices.

To face the described problem of the externalisation of costs, that is, the disregard of a share of the costs, a system focused decision making is necessary. That implies that all effects of the decisions regarding product complexity are taken into consideration (Bohne, 1998; Bliss, 2000). Therefore the author is calling for a system focused company culture. The situation is illustrated in figure 3. It is shown how product complexity is propagating through the system and how feedback with regards of the effects of product complexity should be fed back and made available.

Here Iansiti (1995) provides an appropriate approach. He calls his concept "system focused organization". Since this concept was originally created to evaluate the interaction between novel technical approaches and the existing environment it is

Figure 3: Product complexity as a relative element in the propagation context

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applicable to "connect" product developers with the environment which they are affecting.

System focused organizations can be characterised in the following way. "System focused organizations emphasize an extensive and proactive analysis of the impact of individual design possibilities on the integrated properties of the entire network of design decisions." (Iansiti, 1995). In our case this definition is adapted in way that the focus is on implications of individual design possibilities on the other organizational complexities. If this difference in the set-up is taken into consideration the original definition of system focused organizations can be redefined accordingly. That is, a system focused organization:

- dedicates adequate resources to integrated decision making.
- focuses on the early generation of knowledge of the potential impact of individual decision on the broad characteristics of the existing product and production system
- retains past knowledge of integrated decision making.

Further Iansiti (1995) underlines that a broader problem solving approach is needed to gather all the relevant knowledge needed. Therefore, he argues for cross-functional teams. By doing, so a broader base of disciplinary knowledge is gathered. All these actions are assumed to increase the development performance in terms of being aware of <u>all</u> the implications of development design choices. The approach of a system focused organization is illustrated in figure 4.

Having a strong system focus and problem solving breath are to ways to increase the product development performance in terms of the reduced product complexity level. However, this is not the whole story. The underlying reason is that culture goes deeper than this. Culture can be seen in three layers (Schein, 1985). The first and most superficial layer is what Schein (1985) calls artifacts and creations. Below this first

Figure 4: The system focused organization (Iansiti, 1995)

Figure 5: Three layers of organizational culture (Schein, 1985)
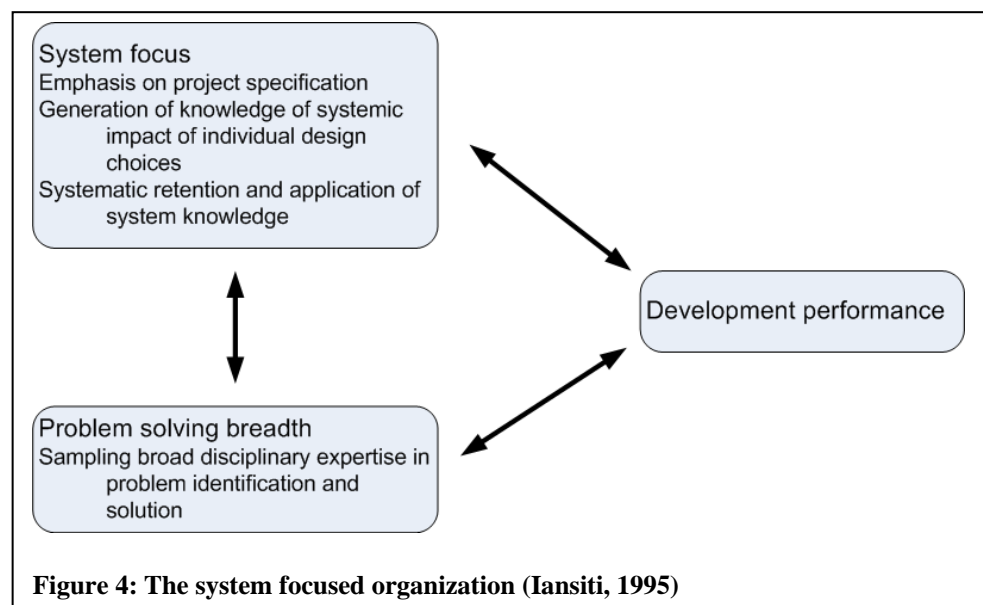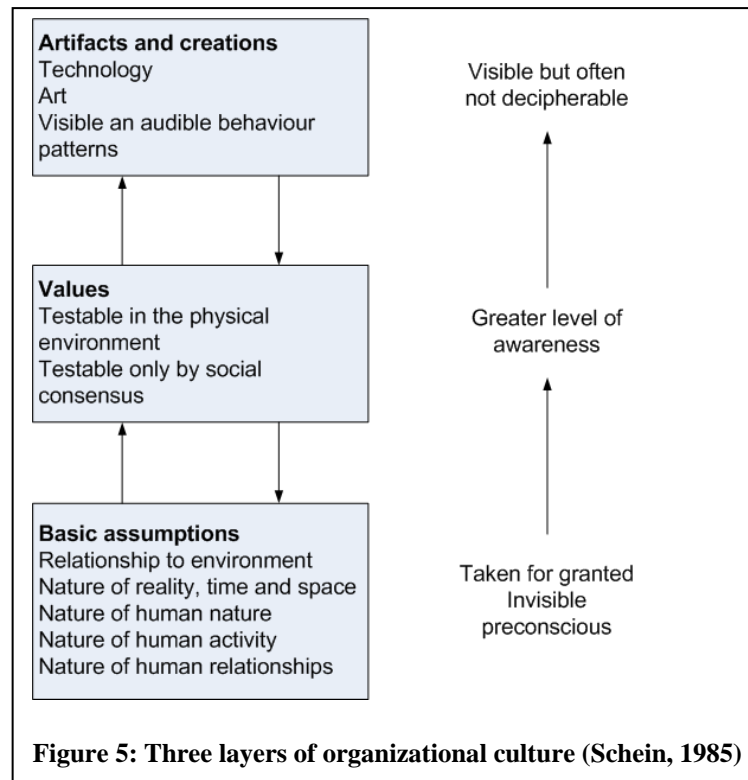
layer one can find values of the people who are part of the group that forms the culture. Below these values one can find basic assumptions. Schein's (1985) definition of culture is illustrated in figure 5. Artifacts and creations are the most visible layer of the organizational culture, that is, its constructed physical and social environment. It includes the technological output of a group as well as its overt behaviour patterns. Although insiders are not necessarily aware of the artifacts one can always observe them. What Iansiti (1995) characterises as a system focused organization, system focus and problem solving breath, can be categorised as artifacts. According to Schein (1985) it is easy to observe these artifacts. So far the first layer of the demanded organizational culture has already been defined. However, the difficult and important part is to understand what these artefacts mean and what deeper patterns they reflect. This is done by analyzing the central values. These are day-to-day operating principles of the group members of a culture which guide their behaviour. Other authors describe values as the basic concepts and beliefs of an organization which form the heart of the corporate culture (Deal and Kennedy, 1982). Strong cultures have rich and complex systems of values which are shared by the members of the group. While values can be questioned, debated and challenged basic assumptions are different in terms of that they are so much taken for granted that they are nonconfrontable and nondebatable (Schein, 1985). Accordingly, there is little variation inside a group when it comes to the basic assumptions and behaviour based on any other premise would be inconceivable. Basic assumptions are on the one hand more general than values but on the other hand more ultimate. Often they have been dropped out of consciousness and are treated as reality. Schein (1985) categories the basic assumptions into five categories as illustrated in figure 5.

According to Schein (1985) it is not enough to define culture only by the artifacts. To provide the full picture of an organisation's culture assumptions and values have to be deciphered as well. The reason is that artifacts, are dependent or built upon the actual

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assumptions and values. In case a strategy with the accordant artfacts is too far out of line with the existing values and basic assumptions it is highly probable that the strategy will not be realised.

In other words, if a strategy for product complexity reduction with its cultural artefacts of a system focused organization and broad problem solving is to be implemented the values of the group members as well as their basic assumptions have to be in line with a product complexity reduction strategy as well. For that reason the values and basic assumptions which are in line with a system focused organization and broad problem solving will be outlined in the remainder. Since it has not been done before to discuss a supporting culture for product complexity reduction the values and assumptions can only be derived from the literature dealing with system focus and cross-functionality.

Values

By reading literature dealing with system focus and cross-functionality several values can be deduced. The first value can be derived from the fact that individuals which integrate functional units have to share more ways of thinking and behaviour patterns than the functional managers share with each other (Lawrence and Lorsch, 1967). That means, to integrate an organization other functions' issues have to be acknowledged and understood. Second, functions eventually have to adapt to other functions' needs. Accordingly, Wolff (1985) names as one hinder to bridge R&D with manufacturing that R&D assumes that their responsibilities end when they push their solution through the manufacturing departments door. This implies that demands between R&D and manufacturing should be balanced (Lawrence and Lorsch, 1967). Although it could be extensive or costly for one function to include the needs of another function it is necessary to realise an integrative organization (Walton and Dutton, 1969). In other words, it should be a guiding principle for all functions to make concessions to other functions in order to improve the overall result of the whole system (Gray, 1985). Third, to be able to do these interfunctional adaptations people have to understand that mutual task dependence is the root cause of interunit conflict (Walton and Dutton, 1969). It is one core value to acknowledge mutual task dependencies since they form the basis for coordination and cooperation demands and very important, to understand them. Fourth, to understand mutual task dependencies open and precise communication is at core (Gray, 1985; Wolff, 1985). By doing so unterunit conflict through ignorance is avoided (Walton and Dutton, 1969). Finally, Walton and Dutton (1969) argue that there could be interdepartmental differences in whether to consider measurable or intangible impacts. However, since the costs of complexity are mostly hidden (Child, Diederichs et al., 1991), it is important to also include results which are hard to quantify as well.

To sum up, the values which are necessary to support a system focused view and broad problem solving are:

- Beside the own departmental drivers, issues of the other functions have to be understood and included in the decision making.
- The best for the whole organization is more important than the best for the single business unit
- Mutual task dependencies have to be discovered since they form the basis for coordination and cooperation demand.
- Communication is good since it avoids a conflict through ignorance.
- Impacts which are hard to quantify have to be taken into consideration as well.

<u>Basic assumptions</u>

  All cultural values are based on basic assumptions. According to Schein (1985) the real culture are the basic assumptions. That is, the cultural values as well as the artifacts are only manifestations of the organizational culture. The question to answer now is what basic assumptions are necessary in an organisation to enable the artifacts and the values discussed above. The basic assumptions can be derived from the already defined values. While deriving the necessary basic assumptions for a low product complexity culture it turned out that not all the categories of basic assumptions which are shown in figure 5 are affected. The categories of basic assumptions which are relevant for a low product complexity strategy are the following:

- Nature of human relationships
- Nature of human nature
- Nature of reality, time and space

Coming to human relationships there are three basic assumptions which can be derived. First, interdepartmental integration is valuable. It is important that people in an organisation are really convinced that it is worth to invest in integration activities. That is, they should try to understand the issues of other functions and include them in the decision making. Therefore, the necessary basic assumption here is that interdepartmental integration is valuable. Second, The systemic view should be taken. This issue is closely related to the fact that organisations would like to achieve their overall goal as good as possible. Therefore, perhaps functional interests have to stand back. Since it is hard to disregard the own functional interests in favour for the overall performance goal there should be a basic assumptions that a systemic view should be taken, that is, effects in the whole organisation should be taken into consideration. Third, mutual task dependence has to be discovered. As already pointed out, mutual task dependencies are at core in integration activities. Since they form the basis for coordination and communication demands a strong focus should be put on the discovery and the understanding of mutual task dependencies. When it comes to the nature of human nature the necessary underlying basic assumption is that humans are communicative, open, trustful and friendly. If an organisation really wants to make mutual interdependencies visible and understand them it demands open communication. Further, there has to be a trustful atmosphere to share all relevant information interfunctionally. Finally, a very important assumption when it comes to nature of reality, time and space is that intangible effects must be acknowledged. As already mentioned, effects and costs of complexity are mostly hidden, that is, they are hard to quantify. However, this does not mean that they are not severe or important. Therefore, these costs have to be taken into consideration in the decision making.
The complete culture to support product complexity reduction efforts in terms of artifacts, values and basic assumptions is summarised in table II.

Cultural Level	Content
Artefact	System focused organization
	Broad problem solving (cross-functional way of working)
Values	Beside the own departmental drivers, issues of the other functions have to be understood and included in the decision making.
	The best for the whole organization is more important than the best for the single business unit
	Mutual task dependencies have to be discovered since they form the basis for coordination and cooperation demand.
	Communication is good since it avoids a conflict through ignorance.
	Impacts which are hard to quantify has to be taken into consideration as well.
Basic assumptions	Interdepartmental integration is valuable.
	The systemic view is the one to take.
	Mutual task dependency has to be discovered.
	Humans are communicative, open, trustful and friendly.
	Intangible effects must be acknowledged.

Table II: Values and basic assumptions to support a product complexity reduction strategy

CONCLUSIONS AND MANAGERIAL IMPLICATIONS

The contribution of this paper is twofold. First, it has been pointed out that a product complexity reduction strategy demands a specific integrative company culture including system focus and broad problem solving. By following a product complexity reduction strategy and at the same time having a supporting company culture at hand product developers are provided with a holistic view. This holistic view implies that developers have information on all effects and cost impacts of a potential design decision. This means that they have more information at hand and therefore are set into the position to design a better product in terms of the overall goals of the organisation. It was pointed out that this culture should put a high emphasis on system focus and broad problem solving. Second, instead of only providing a superficial description of the company the necessary underlying patterns were identified and illustrated. Managers who are applying a product complexity reduction strategy are provided important information to reduce product complexity successfully and durably. By understanding the necessary underlying values and basic assumptions the risk of failure while implementing product complexity reduction strategies is reduced substantially. That implies, to reduce product complexity managers also have to manage the company culture. They have to shape the values according to the product complexity reduction strategy. That is, they have to create a

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rich and logically consistent system of values which is supporting the strategy. Further they have to assure that these values are shared among the members of the organization. If the values are managed successfully and constantly the first successes will be realized. Members of the organization will start to accept and embrace the values and develop the accordant basic assumptions. At this point a supporting culture to reduce product complexity is implemented. Only with an appropriate culture at hand the implementation of a product complexity reduction strategy is promising.

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APPENDIX

Appendix 1: Potential interface connection variants for chosen connection components for the
base module – module 1 interface.

Base module – Module 1		
Media:	**Number of variants**	
	Actual Complexity	**Necessary Complexity**
Pneumatics	65	20
Hydraulics to power steering	20	4
Electrical power	500	100
Electrical ground	2	1
Electrical signal (in thousand)	280	1
Water to power steering system	4	0
Fuel lines	3	1

Appendix 2: Potential interface connection variants for chosen connection components for the
base module – module 2 interface.

Base module – Module 2		
Media:	**Number of variants**	
	Actual Complexity	**Necessary Complexity**
Pneumatics (in thousand)	10	2
Electrical power	800	400
Electrical ground	10	5
Electrical signal (in thousand)	200	1
Fuel hose	20	0
Water pipe	30	0
A/C pipe	110	0
Gear shift cable	7	0
Fuel	20	0
Clutch hydraulic	40	0

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Development Methods for Quality Measurement Tools enabled by Open Source Software

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1. Abstract

The Free and Open Source Software Movement is currently the most interesting and influential trend in software industry as it enables nearly boundless access to software. On the other side future generations of engineers will need more and more profound software knowledge. The article describes a new education level for engineers in quality assurance developed and applied at the Technische Universität Ilmenau.

Through broad application of Open Source Software students without any previous knowledge are enabled to develop a customised multi-layer software system to specific problems of practical relevance. The software system is based on an Office client whether from Microsoft Office or OpenOffice connected with a SQL database server. The paper details which difficulties occurred most often during development and to what extent the developed software solutions could be deployed in industry as a cost efficient alternative.

2. Purpose

University education has its strength in teaching theory and methodical understanding. Nevertheless practical relevance is sometimes absent or acquired knowledge could not be adopted adequately and therefore is forgotten promptly. On the other hand it could be ascertained that most students still have deficiency in software knowledge. That implies the capability to describe a problem in an abstract manner in order to be later implemented easier into software as well as to be well versed with a sort of software tools which are considered as elementary. The necessary knowledge of a certain programming language can thereby differ from case to case. Both Office suites (whether form Microsoft or OpenOffice.org) and SQL databases are considered as very useful tools by the authors of this article in the context of quality assurance.

Microsoft Office (MS Office) is maybe the most distributed commercial software package around the world as it could be widely used and customised by the user himself. OpenOffice (full: OpenOffice.org) is a serious alternative to MS Office as it is Open Source and for free (see "Excursus: Free and Open Source Software" below).

SQL databases are the most commonly used type of databases. A database is an important element of every bigger software information system as it provides a simultaneous access and the possibility of storing and retrieving huge quantities of data.

The lack of software knowledge in industry today is shown in a variety of international surveys (Buschermöhle, 2006; Standish 2004; Sauer 2003). Accordingly, most software projects in enterprises are failing. Either they are cancelled or they are completed at the cost of budget or time overrun or with a reduced functional scope, fig. 1.

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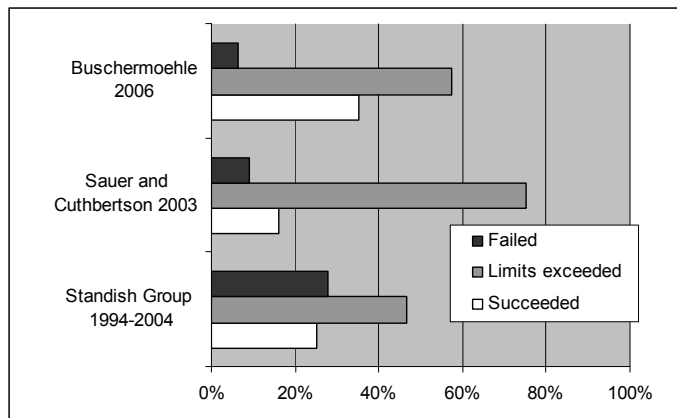
Fig. 1 – Outcomes of surveys investigating software projects in enterprises (Buschermöhle, 2006; Standish, 2004; Sauer 2003)

Nowadays there are different alternatives to consider for software development: in-house development, outsourcing/ Commercial off-the-shelf (COTS) procurement and Free/ Open Source Software (F/OSS). Studies on the application of software for quality assurance in Germany show that only one third of all users purchase Commercial off-the-shelf Software for quality assurance (Waßmuth, 2008; Roßdeutscher, 2007; Krautwasser 2005). Most companies either disclaim the application of any specialised software or develop it by their own (in-house development). The last ones are often based on MS Office (Roßdeutscher, 2007).

Referring to the mentioned deficits in education and industry as well, the British Computer Society (BCS) states: "Improving education will not make an immediate change to practice, but is a vital part of a long-term solution to the problem…" (BCS, 2004).

Therefore a new approach in education has been developed and applied at the Technische Universität Ilmenau. Based on a SQL database server and Office clients students in mechanical engineering are enabled to develop customised software solutions to problems of practical relevance without having any specific knowledge in advance. Applied Open Source Software tools made development process easier and software solutions more powerful on the other hand. The following objectives should be accomplished:

- Enhance knowledge in quality assurance through practical experience,
- Gaining understanding about the process of software development and architecture of multi-layer software systems,
- Learning to work with useful software for later job,
- Training of presentation and teamwork.

From the scientific point of view, the frequent problems at the development of software and the evaluation of quality of software solutions were of particular importance.

Excursus: Free and Open Source Software

The original definition of "Free Software" comes from the Free Software Foundation and it asserts, that a program is free, if the user has the freedom to run, copy, distribute, study, change and improve the software (FSD, 2008). The last ones require access to source code as a precondition. Although the terminology of "free" should be interpreted originally for "freedom" instead of "not to pay", usually it is possible to obtain so referred software without paying money and simply downloading it from the Internet (Balduzzi, 2005).

The "Open Source" definition, on the other hand is quite similar. The Open Source Initiative describes it as a development method for software that harnesses the power of distributed peer review and transparency of process (OSD, 2008).

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The two terms "Free Software" and "Open Source Software" refer to two separate movements, Open Source is a development methodology and Free Software is a social movement. In fact both terms are used to indicate the same kind of software referred to as Free and Open Source Software (F/OSS) (Balduzzi, 2005). F/OSS has some advantages in comparison to "normal" software as well as some weak points, too. The most mentioned Pro's and Con's are summarized in Table I.

Pro's	Con's
lower costs	different stage of maturity
reliability	no guarantee
interoperability	software licences
independency	

Table I – Pro's and Con's of F/OSS (Wheeler, 2008; Balduzzi, 2005; Wieland, 2004)

Firstly F/OSS guarantees lower TCO (Total Cost of Ownership), because there are no licensing fees and users are not tied to monopolistic vendors. F/OSS promises higher reliability, as more people are involved in software development, source code review and usage. F/OSS allows afterwards an easy connection between information systems, because of its access to source code and used standards definitions. Users can re-use and adapt existing open source implementations in other systems. Users do not depend on proprietary providers since other providers have access to the same knowledge and technology (Wheeler, 2008; Balduzzi, 2005).

On the other side there are partly huge discrepancies at the stage of maturity between projects. As F/OOS can be simply downloaded from the Internet for free there is no guarantee on the software and the possibility that software is no longer developed. Furthermore there are different software licenses – some of them have nothing in common with the original definition of "Free" or "Open Source Software". Therefore possible software candidates should be analysed closely. A huge community is always a good indicator as well as high download rates (Wieland, 2004).

Today more and more enterprises and governments starting to adopt F/OSS instead of COTS, for F/OSS usage in governments see fig. 2.
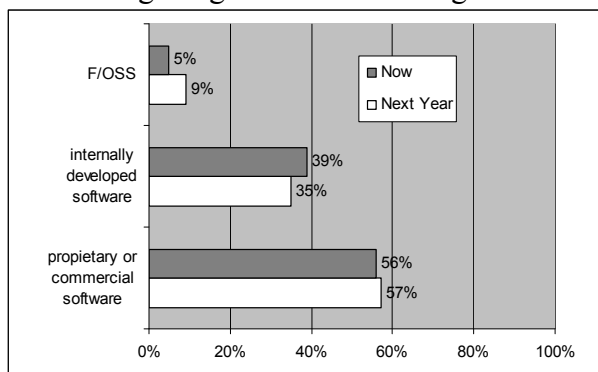
Fig. 2 – F/OSS in Government: Today vs. Next Year; survey found in (Rosenthal, 2006)

Some major companies, e.g. IBM and Sun Microsystems have joined some F/OSS projects and support them. A lot of established businesses provide services around F/OSS for-fee, e.g. consulting, customising or enhancements. The success of the new software movement is shown by many case studies, some very popular are: the Linux operating system, the Apache web server, the Firefox web-browser, the Eclipse development framework, the MySQL database server and OpenOffice as a serious alternative to other Office suites. Huge Internet repositories like www.sourceforge.org and www.freshmeat.net show success of the movement with thousands of registered projects. More information on F/OSS, important projects, different license models etc. can be found on e.g. (Wheeler, 2008).

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3. Approach

The extent of selected F/OSS for education purpose is demonstrated in fig. 3 and shows a viable software architecture which also could be deployed in industry as a cost efficient alternative to COTS solutions.
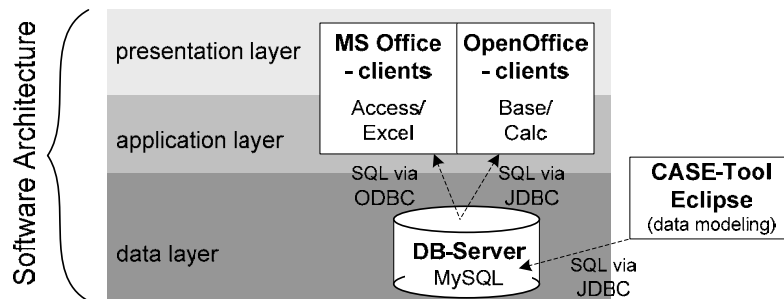
Fig. 3 – Selected software components

The chosen components except Microsoft Office client – are popular F/OSS software: an Eclipse plug-in (Eclipse, 2008) as CASE-tool (Computer Aided Software Engineering) for data modelling, MySQL (MySQL, 2008) as database system and the OpenOffice client (OpenOffice, 2008). Connection between the software components had been made through SQL via JDBC and ODBC middleware.

To build up a complex software system it is necessary to apply a systematic approach. The software lifecycle could be divided into at least four main steps: requirements analysis, design, implementation and maintenance. Using an adequate modelling language, tools can help to verify the underlying model as well as to generate executable code.

In practice data models are of an outstanding importance at the development of complex software systems. Data are the core of every software system. Data do even exist without a certain program and therefore have a higher stability then the program itself. Although the data model is just one part of system development, it has a strong impact on the later software, i.e. user requirements, application integration and costs (Ponniah, 2007). A data model provides a method for describing the real-world information requirements in a manner understandable to all stakeholders. It also serves as a blueprint of the database system for the developers. The adopted approach to create an Office - database centred software system is shown in fig. 4. All main steps of software lifecycle mentioned above are included.

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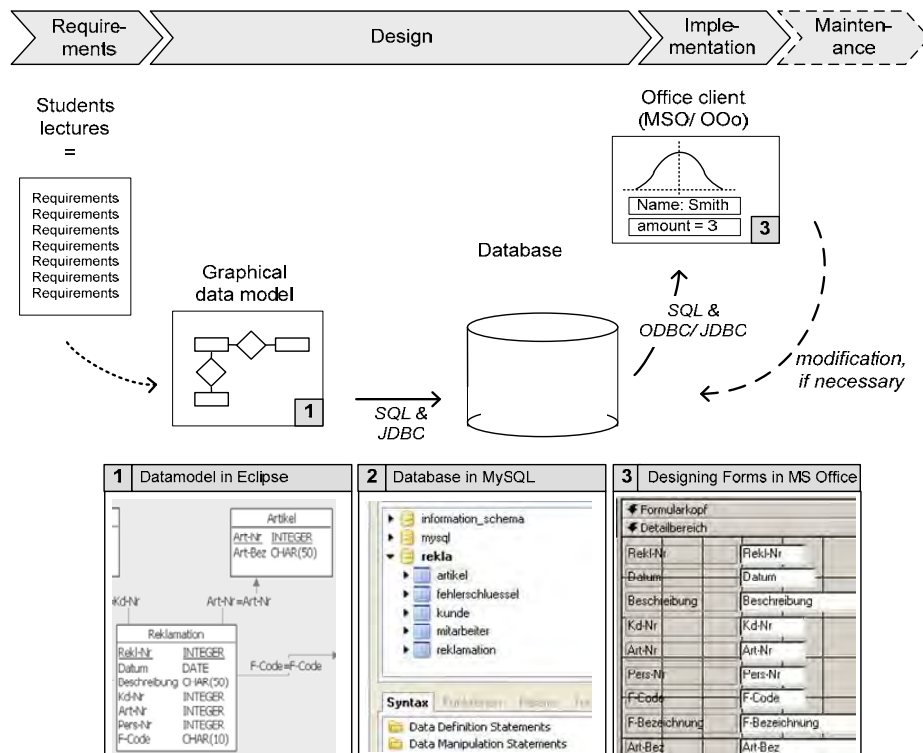
Fig. 4: Development process and applied software components

Every group was made up of two or three students and had to select a typical field of interest in quality assurance to be later realised with software. At the beginning each student had to give a lecture which should include the theoretical basics as well as a plausible example to the other students. The lecture was also seen as the requirements document and the result of requirements analysis.

4. Findings

With one exception all groups had shown viable Office clients using Microsoft Excel/ OpenOffice Calc and/or Microsoft Access/ OpenOffice Base. (Note: Initially only Microsoft Office package had been used. From the second semester on also OpenOffice.org had been applied.)

Typical software tools which had been realized are, among others:

- Machine and Process Capability Analysis,
- Statistical Process Control (Control Charts),
- Acceptable Quality Level (AQL) Sampling Inspection,
- Supplier Assessment,
- Complaints Management,
- Failure Mode and Effects Analysis (FMEA),
- …

Relevant data as master data and measuring data could be entered into the program by manual input, by data file like *.csv or even through connection to database, using SQL-commands. To following both examples should an overall impression of realised software solutions

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<u>Example 1 – Supplier Assessment</u>

Fig. 5 shows the students data model for supplier assessment as domain of interest.
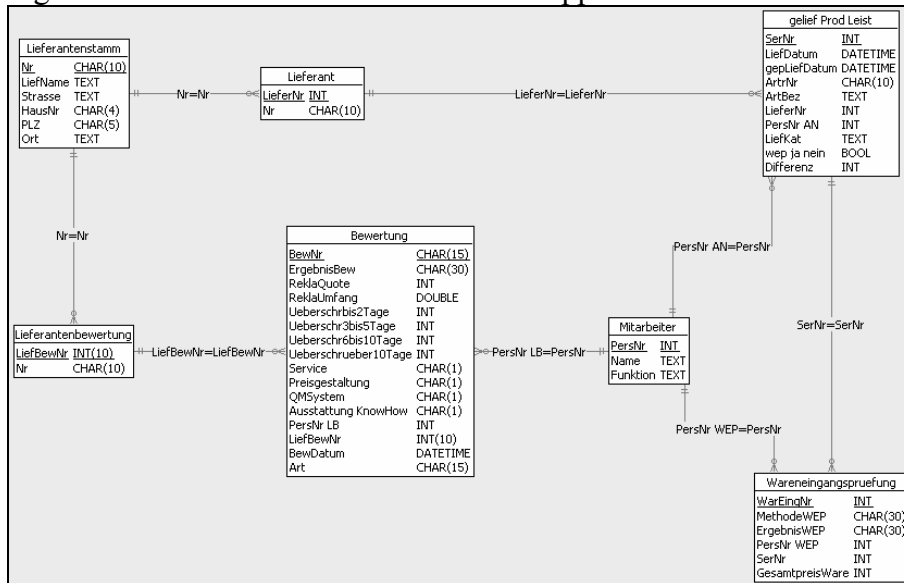
Fig. 5: Students data model "Supplier Assessment", made with (Eclipse, 2008)

The program covers elementary functionality for supplier assessment: management of necessary master data like supplier and material, the handling of goods inspection and the integration toward supplier assessment, fig. 6. The management of supplier assessment includes the calculation of hard facts as delivery reliability or error rates as well as soft facts like benchmarking the overall service quality or the quality management system.

Fig. 6: "Supplier Assessment", left side: Microsoft Office, right side: OpenOffice

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<u>Example 2 – Statistical Process Control</u>

Purpose of this Statistical Process Control is monitoring a process routinely through the use of attribute control charts. The first picture shows underlying data model supporting process specific data and measuring data of certain characteristics, fig. 7.
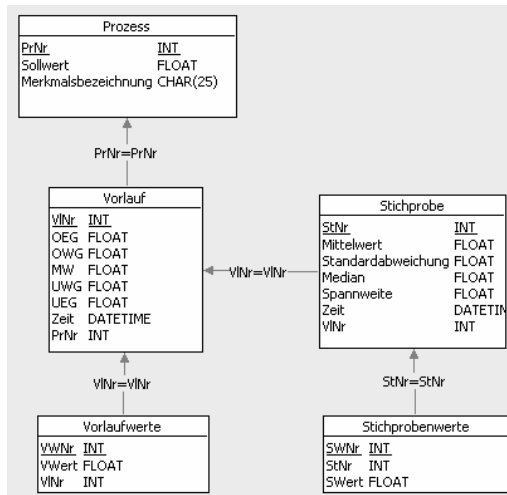
Fig. 7: Students data model "Statistical Process Control", made with (Eclipse, 2008)

The software solution allows data input through forms in Microsoft Access or OpenOffice Base. Data are equally stored in the MySQL database. Measured data could be retrieved from the database or imported via *.csv file. The calculation was realised within Microsoft Excel or OpenOffice Calc. Both programs calculate corresponding upper/ lower control and action limit and plot the chart automatically, fig. 8.
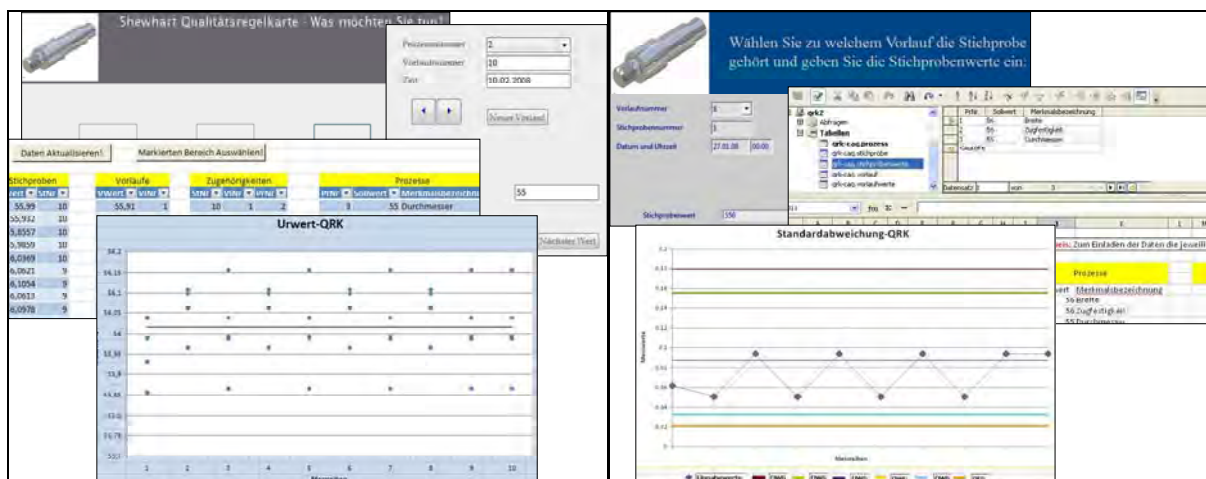
Fig. 8: "Statistical Process Control", left side: Microsoft Office, right side: OpenOffice

Of the 68 students who attended the courses during that two semesters from the beginning only 47 passed it successfully. Those who changed (all within the first three weeks) reclaimed the additional effort regarding to a "normal" course. At the beginning and at the end of the semester a standardised questionnaire was handed out to each student. One intention was to evaluate student's knowledge concerning Microsoft Office/ Open Office and databases, both through self assessment and control questions. Fig. 9 shows a good correlation and an overall remarkable increase in knowledge.

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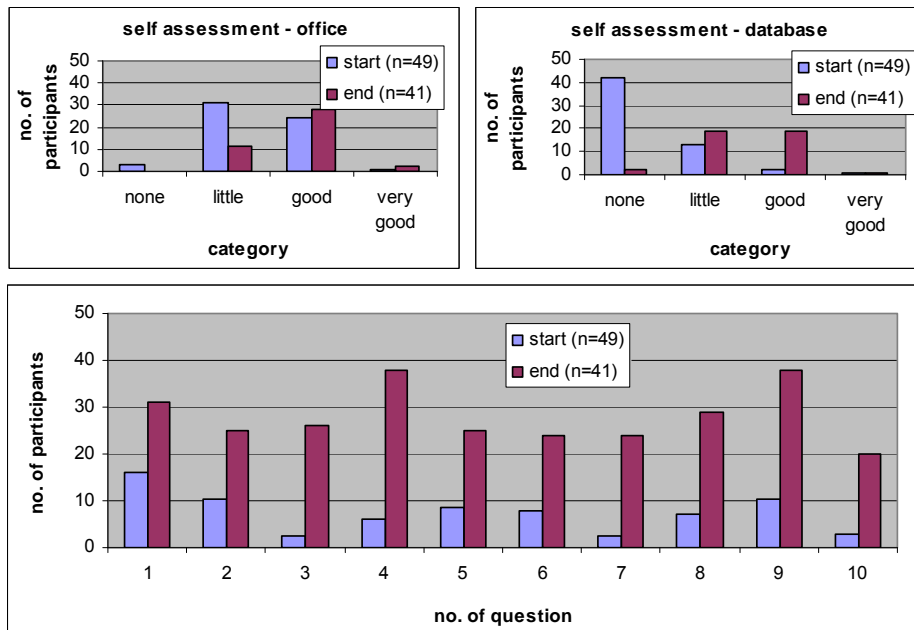
Fig. 9: Increased knowledge, above self assessment – below control questions
         (n=41, note: six forms were not applicable)

Another matter of interest was to find out what caused the most problems: creating the database or programming the Office client. For that purpose ten points had to be allocated. The number 10 stands for "most difficult". Fig. 10 illustrates the results as Box-Whisker Plot. According to this students had more problems with Office than with the database.
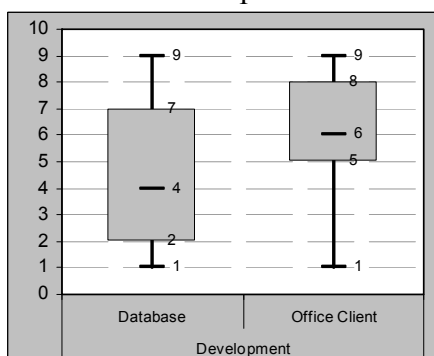

Fig. 10: Problems at the development: 10 – difficult, 0 – easy (n=41)

From the second semester on students should additionally develop a second client version with OpenOffice. To compare both clients students had to fill out a questionnaire to evaluate differences between Microsoft Office and OpenOffice. For that purpose 10 points had to be allocated among the two Office suites. A high number stand for higher quality. For evaluation of software quality four criteria had been chosen: Usability, Reliability, Efficiency and Functionality. These four criteria are part of the international standard ISO 9126 (ISO9126, 2001) used for classification of software quality:

• Usability measures the effort needed for use by a set of users.
• Reliability measures the capability of software to maintain its level of performance under stated conditions for a stated period of time.
• Efficiency measures the relationship between the level of performance of the software and the amount of resources used under stated conditions.
• Functionality measures existence of a set of functions and their specified properties. The functions are those that satisfy.

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The standard additionally mentions Maintainability and Portability which emerge mainly in the last step of software lifecycle and therefore could not be evaluated by students so far.
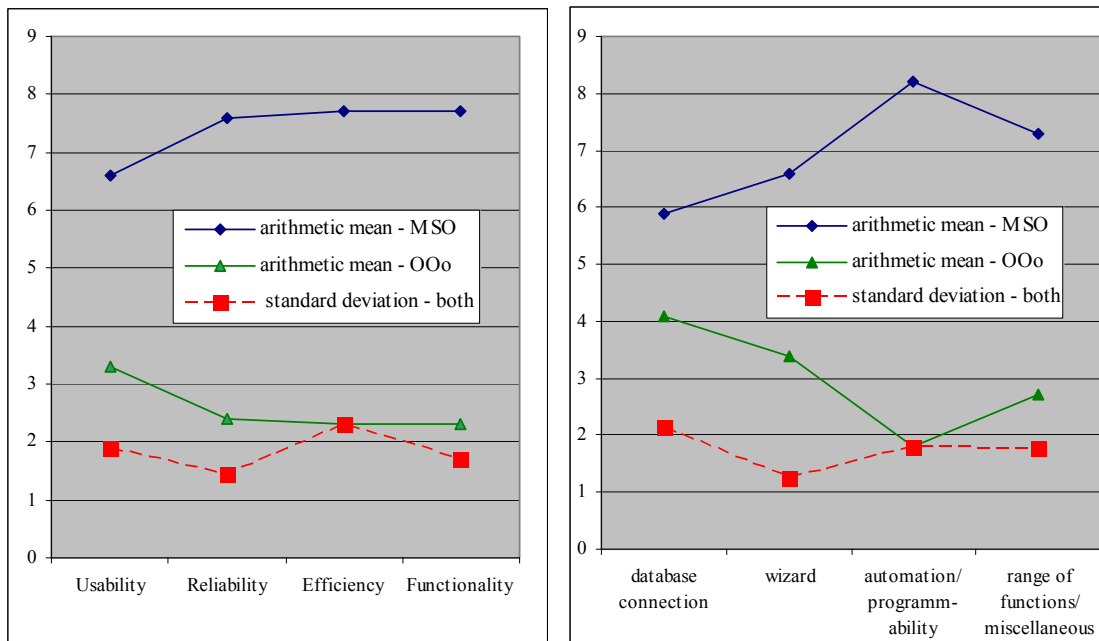

Fig. 11: Evaluation of both Office suites regarding specific quality criteria (left side) and commonly used functions (right side), n=14

Fig. 11, left side, shows assessment between Microsoft Office and OpenOffice through quality criteria. Microsoft still beats OpenOffice beyond all criteria. Although regarding "Usability" Microsoft Office and OpenOffice are quite close to each other. Similar results show the right picture of Fig. 11. Additionally to the four criteria students had to assess typical functions in Office accompanying the development process. Regarding to this OpenOffice still has some graver weak points in programmability and therefore automation whereas installing the connection to database server (here: MySQL) worked very well on both Office suites.

Although most students had indicated fewer problems with the database (fig.10) it was evident that in most cases data models could only be applied to that special use case for which it was planed. By using the relational data model and suitable database design tools, building a database is not that difficult in fact. The problem lies more in the modelling effort or rather the development of models of higher quality (Simsion, 2005), fig. 12.
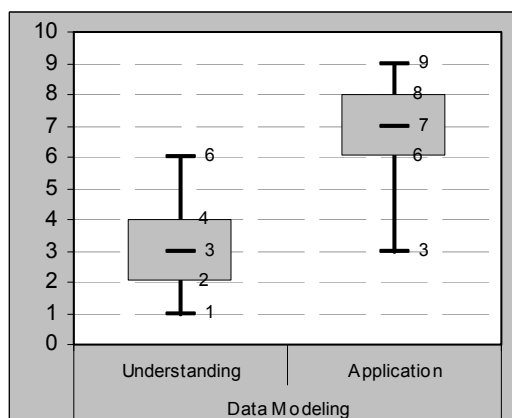

Fig. 12: Problems in data modelling: 10 – difficult, 0 – easy (n=41)

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In principle there is always more than one solution to a certain (modelling) problem. The quality of a data model refers to understanding and evaluating the data model regarding customer's expectations (Shanks, 1997). In literature a lot of criteria frameworks have been proposed which can be used to understand and evaluate quality of data models (Shanks, 1997; Genero, 2002; Patig, 2006; Calero, 2002). Those quality criteria which are frequently mentioned and most important are:

- Correctness: A model should conform to the syntax rules of the particular notation.
- Completeness: Does a model include all necessary information? What can be expressed?
- Flexibility: Changing requirements should not cause changes to the data model or at least no drastic changes.
- Understandability: It can be achieved through simplicity and naturalness.

Some empirical studies on data modelling (Hitchman, 1995; Shanks, 1997; Castro, 2005; Leung, 2005; Simsion, 2005) have shown that:
- Data modelling novices didn't have problems using simple semantic constructs. Difficulties had increased by dealing with complex constructs and on a larger domain of interest.
- High quality data models can be achieved by a systematic approach. Experts are able to create better models due to there ability of abstraction, they use patterns of former projects and spend more time to review their models than novices do.

Regarding to fig. 10 only few students weighted "database development" higher respectively more difficult. It may be assumed that those students put more effort to adjust their data model and so created better models, see fig. 13.
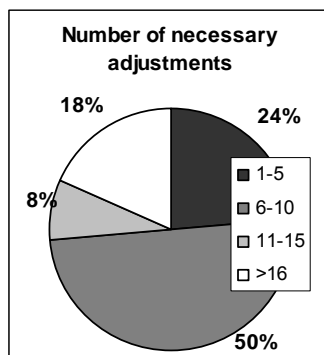

Fig. 13: Number of adjustments to data model (n=41)

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5. Originality

The paper presents a systematic approach for development of customised quality measurement tools. The new approach had been tested with students at the Technische Universität Ilmenau. Because this method could be applied so easily and is so effective as well, it has now become an integral part of education in quality assurance at the Technische Universität Ilmenau. As it had been outlined, students were able:

- To create small individualized software applications for quality assurance using Office clients and a SQL database system,
- Without any previous software knowledge (fig. 10),
- And to develop and customise it by there own in a relatively short time – a necessary attribute for effective working with software.

During development every group became well aware of all those problems and necessary steps which have to be overcome and are so typical in every major software project. This training approach had been enabled only through broad application of F/OSS software tools, rapid testing and customizing as well as through good software documentation on the Internet and program assistance within the tools.

Most developed software solutions were limited to the initially proposed course examples instead of covering a more general application range. This was mainly due to limitations of the underlying data model. Developing high quality data models needs both comprehensive expertise and data modelling understanding. Nevertheless the majority of all participants were very enthusiastic regarding the new approach in education compared to standard courses, fig. 14. Interestingly nearly one half of the students were quite sceptical at the beginning of the course.
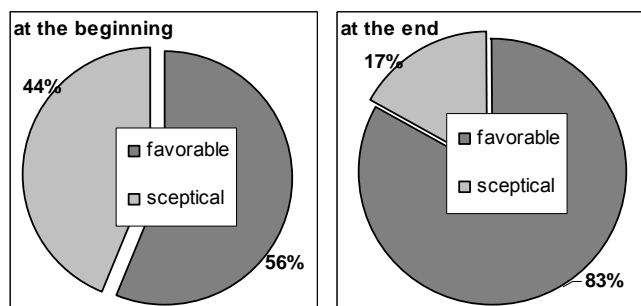

Fig. 14: Attitude to course at the beginning and at the end (n=41)

Keywords: education in quality assurance, database and Office-client, software development
Paper type: Case study

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A successful statistical procedure on kansei engineering products

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Abstract

Purpose－Kansei Engineering have been applied to so many different industrial fields. This is a new example of application of Kansei Engineering in packaging designing of bathtub salt.

Methodology－Kansei words were selected according to the project concept and 23 sample product were chosen from the different manufacturers. Before the kansei evaluation experiment, the item/category which mean the new packaging design properties were decided and thirty adult subjects evaluated these samples on 5-point kansei SD scale. These data were analyzed by Principal Component Analysis, Factor Analysis and Partial Least Square Analysis.

Findings－From statistical analysis, we found two main factors which consisted of aesthetic and young-resort kansei. From Partial Least Analysis, these new concepts were transferred to new design specifications that became the basic design concepts. After then, we conducted the reconfirmation survey by retesting the old and new packaging design through Kansei Engineering procedure. As the results, it became clear that the new packaging design were excellent compared with the old one.

Keywords: Kansei Engineering, Kansei Methodology, Development of Bath salts,
Statistical kansei analysis, Kansei packaging design

Category: Technical paper

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1. Introduction

Kansei Engineering was founded 35 years ago at Hiroshima University and since then more than 30 new products have been developed using Kansei Engineering. All Kansei products sold well and made a lot of profits the manufacturers.

Kansei Engineering is defined as a technology that translates for costumer's kansei(psychological feeling) into design specifications (Nagamachi, 2008). Kansei Engineering is some time useful in creating a new invented product. Nagamachi invented a quite unique refrigerator in Sharp which is a reversed shape style with a vegetable compartment at the top and freezer at the bottom. This type of refrigerator is a standard in Japan nowadays. He supported Sharp Kansei team to invent an original video camcorder, in which the camera lens can rotate in 350 degree with liquid crystal display. This was extended technically to the kind of digital camera that many people now possess.

We have developed a lot of Kansei Engineering methodology to produce the kansei products. Category Classification which was used to create Miata from Mazda, Computerized Assisting System which is called as Kansei Engineering System, Virtual Kansei System which is a integrating Kansei Engineering and Virtual Reality Technology, Vehicle room space diagnosis system using Genetic Algorithm, Word Image Diagnosis System (WIDIAS), Hybrid Kansei Engineering which has double kansei systems of forward Kansei Engineering and backward Kansei Engineering, and Kansei Rough Set Model. We utilize a standard kind of Kansei Engineering in general, if it is applicable, which is called Kansei Engineering Type I. In this paper, we treat this method in detail in the application to bath salts.
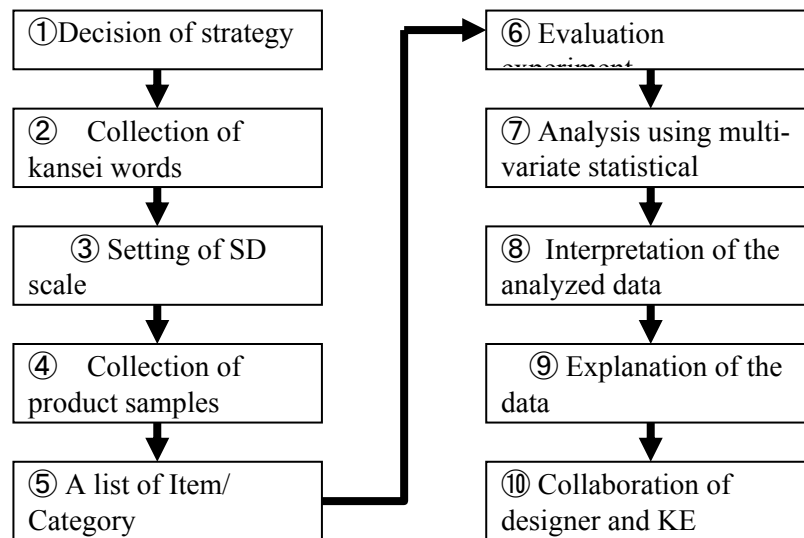
① Decision of strategy	⑥ Evaluation experiment
② Collection of kansei words	⑦ Analysis using multi-variate statistical
③ Setting of SD scale	⑧ Interpretation of the analyzed data
④ Collection of product samples	⑨ Explanation of the data
⑤ A list of Item/ Category	⑩ Collaboration of designer and KE

Fig.1 A flow of the kansei engineering type I.

Figure 1 illustrates the general flow of Kansei Engineering Type I.

① Company strategy:

Kansei Engineering starts from the decision of a client company strategy. The company wishes to create a new product in a specific product field using Kansei

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Engineering. The company should have the specified concept or strategy for the new product. The kansei engineer has to utilize this strategy to apply to the new field.

② Collection of kansei words

The next step after decision of the new strategy is to collect the kansei words related to the new product concept (about 20-30 kansei words).

③ The collected kansei words are arranged on a 5-point or 7-point SD scale. The 5-point scale is better for panel's work on easy evaluation.

④ Collection of other product samples

For comparison among the similar products from the company and other makers, samples are collected from the different companies including benchmarks (about 10-20 samples).

⑤ A list of Item/Category

Item/Category implies the design specifications concerning collected sample products. All product properties are described, for instance colour, shape, size, logo mark, etc.

⑥ Evaluation experiment

After employment of panels of male and female (students or adults), all subjects participate in the evaluation experiment. They record their feelings with kansei words to each sample on the SD scale sheet.

⑦ Statistical Analysis

The evaluated data are analyzed by statistical methods, especially by the multivariate statistical analysis.

⑧ Interpretation of the analyzed data

All analyzed data should be interpreted from the viewpoint of Kansei Engineering. Our purpose is to find the relationship between human kansei and product property. From the analyzed data we find the relations of each kansei with design specifications.

⑨ The explanation of data

The data interpretation should be explained to the company designer(s) in order to make the new design with the help of the designer(s).

⑩ Collaboration with designer(s)

The kansei engineer motivates the company designer(s) to create the new emotional product design stepped up over the analyzed data. In this process, the kansei engineer should support the designer's creation based on the kansei engineering data. This is a kind of collaboration between the kansei engineer and the designer(s).

2. Application of Kansei Engineering to bathtub powder packaging design

2.1 Company strategy for bathtub powder

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Tsumura Life Science Co., Ltd is one of very well known companies as a maker of bath salts. The management of Tsumura Life Science Co., Ltd wanted to increase the company profit from bath salts sales. He asked Nagamachi to create a more fascinating packaging design for summer bath salts, COOL series. Nagamachi recommended the management to create the modern packaging design using Kansei Engineering method. Marketing survey tells us that the bath salts are selected mostly by housewives. Therefore, we decided to do the kansei engineering research on housewives feelings on bath salts

2.2 Collection of kansei words

Nagamachi proposed Tsumura Life Science Co.,Ltd to organize the kansei engineering project team of which mission is to create more emotional packaging design for COOL series, based on the kansei engineering procedure. First we started to collect the kansei words. Nagamachi has met the team to discuss about the kansei engineering procedure and we decided that he collected the kansei words from the viewpoint of bathtub kansei and that the team asked the sales people to write down the customers' words concerning bathtub life.

We constructed the 5-point SD Scale with 45 kansei words as shown in Table 1, in which there are three stages, feeling for looking at the packaging design, feeling after opening the lid and feelings when putting the material into the bathtub.

2.3 The evaluation experiment

We collected 23 samples from five different makers. We invited 30 adult subjects (17 males and 13 females) and asked them to evaluate these samples on the 5-point SD scale. The experiment was conducted in Tokyo and in Hiroshima separately.

Table 1. A list of kansei SD scale.

```
Kansei SD Scale List
(1). Feeling waching at the packaging design
    1 Easy to hold up              □ □ □ □ □
    2 Easy to open the cover       □ □ □ □ □
    3 Prem ium                     □ □ □ □ □
    4 Highly qualified             □ □ □ □ □
    5 Gorgeous                     □ □ □ □ □
    6 Sophiscated                  □ □ □ □ □
       ....                        □ □ □ □ □
       ....                        □ □ □ □ □
   32 Want to buy                  □ □ □ □ □
(2) Feeling after opening the cover
    1 Easy to open the cover       □ □ □ □ □
    2 Easy to open the middle cover □ □ □ □ □
    3 Easy to measure the material □ □ □ □ □
(3) Feeling after putting into the bathtub
    1 Clear                        □ □ □ □ □
    2 Like southern country sea    □ □ □ □ □
       ....                        □ □ □ □ □
       ....                        □ □ □ □ □
   10 Want to use daily            □ □ □ □ □
```

Fig. 1   Samples used in the kansei experiment.

3. Statistical Analysis

3.1 Factor Analysis

First of all, we conducted Factor Analysis to find a small number of factors which will constitute the 23 dimensional bathtub sphere. We found five factors as follows:

(1) Contribution

From cumulative contribution in Factor Analysis (see Table 2), five factors can explain 86.06% concerning the bathtub kansei dimensions. Factor 1 has 35.63%, in contribution and this factor is the largest factor. Other factors have almost the same weight. Accordingly we can say that psychological sphere of the bath salts consist of these five factors. On the other hand, from Table 3, we can find which kansei is weighed more in each factor. In Factor 1 "relax", "colourful", "want to buy", "effectiveness" and others are of importance as the effectors, and this factor will be named "Healing Effectiveness". In Factor 2 "effective to skin", "smooth skin" has the larger weight and this factor will be named "Effectiveness to Skin". Factor 3 concerning" individuality"," fresh", "celebrity", " premium" and so on are important factors and we can name this factor as "High grade designing". Factor 4 has large weight in "young",

Table 2 Contribution table.

Eigen value after varimax rotation

	square sum	contribution	cumulative
Factor 1	11.40144	35.63%	35.63%
Factor 2	4.711995	14.72%	50.35%
Factor 3	4.654092	14.54%	64.90%
Factor 4	3.730676	11.66%	76.56%
Factor 5	3.040801	9.50%	86.06%

Table 3. Factor loading table

Factor 1	Factor 2	Factor 3	Factor 4	Factor 5

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11.good ser	0.807	31.effective	0.301	13. m atch t	0.395	6.sophi stic	0.243	6.sophisti	0.224
20.free from	0.813	4.highly qua	0.345	32.want to b	0.411	29.healing	0.269	4.highly qu	0.237
16.understa	0.846	3.prem ium	0.397	6.sophisticat	0.455	5.gorgeous	0.276	25.effecti	0.243
10.good des	0.861	30.celebrity	0.422	4.highly qua	0.503	30.celebrit	0.323	11.good s	0.25
22.effective	0.865	13. m atch t	0.435	27.clean fair	0.511	27.clean fa	0.446	26.sm ooth	0.328
17.good qua	0.868	23.become t	0.548	5.gorgeous	0.554	23.become	0.455	27.clean f	0.35
31.effective	0.87	2.easy to op	0.669	3.prem ium	0.585	24.refresh	0.524	13. m atch	0.365
32.want to l	0.873	8.fem inine	0.775	30.celebrity	0.596	28.resort f	0.805	1.easy to	0.523
12.colorful	0.884	26.sm ooth s	0.84	18.fresh	0.842	7.western	0.907	19.clear d	0.896
21.relax	0.922	25.effective	0.885	15.individual	0.891	9.young	0.925	14.simple	0.936

"western" and "resort" kansei and we can name this as "Young Resort-like Sense". Finally Factor 5 may be named as "Simplicity", because there are "simple" and "clear design" kansei. These important kansei should be selected as design specifications in the final designing stage.

3.2 Principal Component Analysis

Principal Component Analysis (PCA) is very useful for decisions on the new product strategy. We applied PCA to the bathtub kansei data and obtained the relations between kansei and samples as shown in Figure 2. This figure shows number of kansei vectors which suggest the strength and directions of each kansei and sample positioning as dots. The figure illustrates each sample position in principal component sphere and we can see how each sample is close to what specific kansei direction.
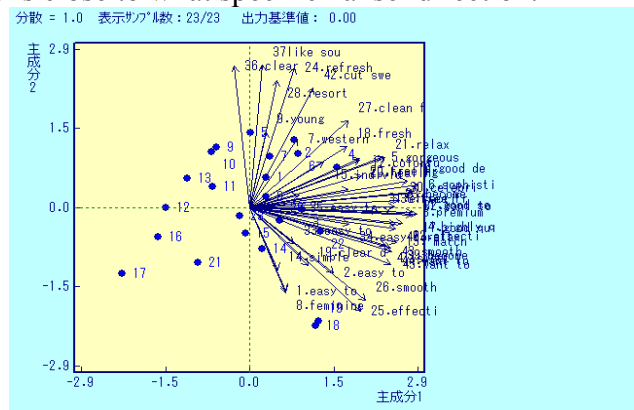

Fig. 3 Positioning of samples related to 32 kansei words

Cumulative contribution of PCA is almost the same as the results of Factor Analysis. Five principal components can explain over 80% f the data. The 1st component has 44% in contribution and other components have almost the same weight as the same as in Factor Analysis. Figure 3 illustrates the dimension surrounded by Component 1 and 2. Many kansei gather around Component 1 which means "Good Sense, Leading to Healing"and Component 2 "Resort Feeling". Accordingly the final strategy of the new packaging design should be heading to a combination of "Good Design Sense" and "Resort Feeling". Tsumura Life Science Co.,Ltd 's products are No. 1, 2, 3, 4, 14, and 22. In Figure 3, No. 3 are close to Component 1 and No 2and 4 are on Component 2.

3.3 Selection of strategic kansei words

In this stage we understand now that we should select the appropriate kansei words leading to the strategic packaging design. We know that we have two factors, one

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consisting of Component 1 and another consisting of Component 2. The components coincide with Factor 1 and Factor 3 in Factor Analysis.

Component 1 consists of "sophisticated", "premium", "highly qualified" ,"good design" and "want to buy", that is a combination of aesthetic factor plus purchase motive .

Component 2 consists of "young" and "resort". We can reach good design if we transfer these two components to the new packaging design. For this purpose we have to find the Item/Category related to these kansei.

3.4 Experiment pouring the material into hot bathtub water

We conducted the evaluation experiment when pouring the material into bathtub. When pouring material into bathtub, it makes a good smell and the hot water changes colour for instance white, pink green or blue, etc. The subjects evaluate these changes on the 5-point SD scale.

The contributions are focused on Component 1(64.4%) and Component 2 (27.7%), totally 92.1% for two components. Component 1 consists of "smooth skin", "become healthy" and "want to buy", and Component 2 of "cut sweat", "relax" and "feel southern country-sea".

These kansei will be added to the final decision of selecting the strategic kansei reaching to the new product packaging design.
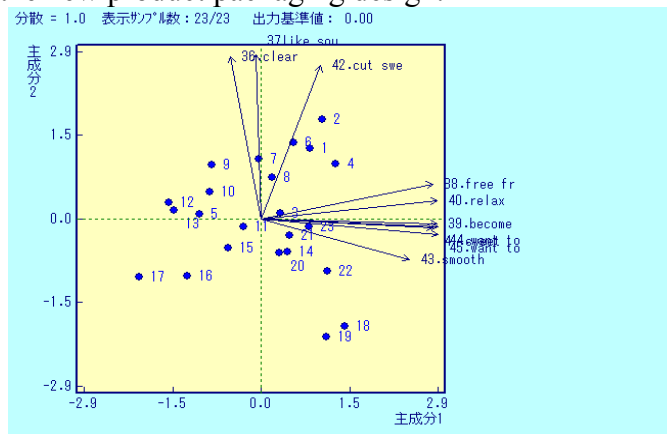

Fig. 4. Positioning of material in the hot water experiment.

3.5 PLS (Partial Least Square) Analysis

PLS Analysis leads to Item/Category, namely to the new product properties with design elements. We already have the candidates of important kansei words concerning the new design. Before conducting PLS calculation, we wrote off Item/Category list related to 23 product samples and we calculated PLS based on 32 items/120 categories. We obtained the relation list between the candidate kansei and each Item/Category concerning 14 strategic kansei. Table 3 shows a part of PLS calculation results.

Table 4. A part of PLS calculation for strategic kansei.

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	Item	Category	3.premium	4.high qual	5.gorgeous	6.sophistc	10.good desig
		Intersection	2.779532	2.894091	2.586308	2.836594	2.9158588
1	Logo	Logo	0.029991	0.022021	0.032302	0.025016	0.0240024
		No logo	−0.02999	−0.02202	−0.0323	−0.02502	−0.024002
2	Number of comments	No comments	0.100562	0.077618	0.024438	0.056021	0.0249342
		one comment	0.013363	0.016373	0.027373	0.024779	0.0348228
		Three comment	−0.05396	−0.03072	−0.04295	−0.0489	−0.04295
		Four comments	0.015202	−0.01745	0.05355	0.011327	0.0088825
		No relation	−0.02999	−0.02202	−0.0323	−0.02502	−0.024002
3	Number of	One color	−0.02324	−0.01408	−0.0392	−0.01762	−0.035697
		Two colors	0.017868	0.009939	0.012273	0.010878	0.0393882
		Three colors	0.051175	0.042968	0.04976	0.017032	0.019695
		Four colors	0.005262	0.010012	0.008343	0.02064	0.0117418
		More than five	−0.02142	−0.02662	0.00586	−0.02077	−0.018827

PLS table shows that the biggest positive value in each column means the design item which should be selected and that the biggest negative value leads to the bad design. In Table 4, "Logo", "No comment" and "Three colours" should be selected for premium kansei. Following this procedure, we checked all of strategic kansei design specifications. The strategic kansei were as follows:

Component 1: sophisticated, premium, high quality, good design, sensitive, want to buy.

Component 2: young, resort, feeling southern country sea.

We integrated all item/categories related kansei of Component 1 and 2 and drew the new packaging design.

4. Final design

After following the procedure described above, we created the following designs.

A   **B**   **C**

Fig. 5   The new packaging designs, peppermint, lemon and rose geranium.

5. Reconfirmation of the hew packaging designs

We conducted a reconfirmation survey about the new packaging designs to see whether the new ones fitted to the customers' upgrade feeling. We utilized the same kansei words which we used in the former research. They were 32 kansei words concerning kansei watching at the outside package.

Nine female subjects who joined the former research participated in the reconfirmation research. The new packaging designs (A,B,C) and the former designs (a, b, c) were arranged in the experimental room and each subject evaluated a product

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randomly on the 5-point SD scale sheet. The evaluated data were analyzed by PCA. Figure 6 is one of analyzed data by PCA. In Figure 6, No.1, 3 and 5 are the old designs a, b and c, and No.
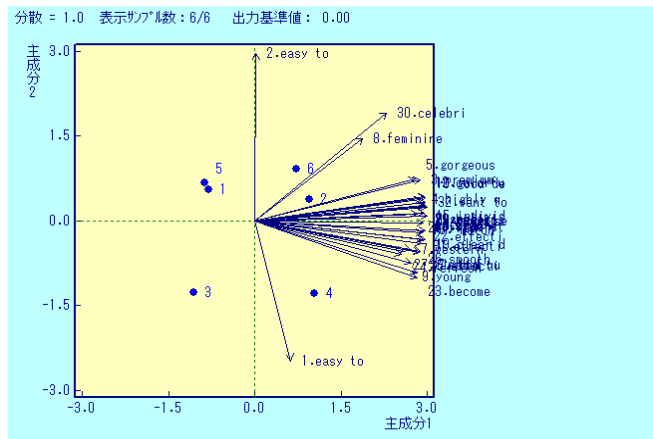

Fig.6. PCA chart of reconfirmed research for Component 1 and 2

2, 4, 6 are the new designs, A, B and C. It is clear that A, B, C positions are apart from the old designs. A is on the aesthetic factor of "sophisticated" ," premium" and others, B is close to "young", and C is on "celebrity" factor. It is clear that the new designs moved to the side of strategic area.

We estimated statistical differences between the new designs and the old ones. The estimation tells us that there are meaningful differences with $p<0.0001$ between the new designs and the old ones.

5. Conclusions

We tried an application of Kansei Engineering to the new packaging design of bath salts. Following Kansei Engineering Type I procedure, we collected the kansei words (45 words) related to the evaluation of bathtub powder and collected the product samples (23 products). The evaluated data were analyzed by multivariate analysis and then we decided the new design specifications based on the statistical calculation. Collaboration with the designers who understood the kansei data provided us the beautiful new packaging designs.

The new designs were reconfirmed by another kansei survey and the evaluated kansei data were analyzed by difference estimation and PLS as well. Both analyses suggested the new packaging designs were excellent and more emotional over the old ones.

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"Seven Tools for New Product Planning": Powerful Tools for Kansei Engineering

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Abstract

Purpose – This paper introduces the "Seven Tools for New Product Planning," proposed by Kanda, Nagasawa, *et al.* in 1995, revised in 2000, those are a set of tools to create hit products appealing to the *Kansei* of consumers.
Methodology/approach – The details of "the Seven Tools for New Product Planning" will be described in this article. These tools are as follows;
(1) Interview Survey: Qualitative survey technique for arriving at hypotheses
(2) Questionnaire Survey: Quantitative survey technique for verifying hypotheses
(3) Positioning Analysis: Method of positioning products and directing planning
(4) Idea Generation: Procedure for efficient generation of ideas
(5) Idea Evaluation and Selection Analysis: Method of evaluating and objectively selecting ideas
(6) Conjoint Analysis: Technique for identifying optimal concepts
(7) Quality Table: Method for linkage of Planning and Design
Findings – This article describes the "Seven Tools for New Product Planning" in broad generalities and discussed the stage in process planning in which they should be used. The details of these seven tools will be discussed in this article.
Research limitation/implication – We insist that the "Seven Tools for New Product Planning" are also effevtive and powerful for *Kansei* Engineering.
Originality/value – Though the "Seven Tools for New Product Planning" are well known in Japan, those are not globally introduced because there are quite a few papers and books concerning the "Seven Tools for New Product Planning."
Keywords – *Kansei*, new product planning, Seven Tools for New Product Planning, total quality management (TQM).
Paper type – Overview.

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1. Introduction

The "Seven Tools for New Product Planning," proposed by Kanda, Nagasawa, *et al.* in 1995, revised in 2000, are a set of tools to create hit products appealing to the *Kansei* of consumers. It is designed to be used systematically as if it contains the story and is a methodology that can be usefully employed to generate creative new products satisfying the objective needs of customers by systematizing the product planning process and combining marketing and originally developed methods with QC methods. In particular, the "impact" found commonly in hit products is an important feature. From this viewpoint, we introduced QC methods formulated to realize the ideal product planning system instead of the traditional QC approach. "Seven Tools for New Product Planning" consist of the following tools:

(1) Interview Survey: Qualitative survey technique for arriving at hypotheses
(2) Questionnaire Survey: Quantitative survey technique for verifying hypotheses
(3) Positioning Analysis: Method of positioning products and directing planning
(4) Idea Generation: Procedure for efficient generation of ideas
(5) Idea Evaluation and Selection Analysis: Method of evaluating and objectively selecting ideas
(6) Conjoint Analysis: Technique for identifying optimal concepts
(7) Quality Table: Method for linkage of Planning and Design

This article argues the verification of "Seven Tools for New Product Planning."

The Seven Tools for Product Planning (or "P7") have been developed and are recommended as techniques for creating "hit" products that will appeal to the *Kansei* (feeling or sensibilities) of consumers.

They are a set of powerful, easy-to-use tools designed to foster product planning that leads to certain success.

Nagasawa (2003) introduced some cases where corporations were able to get good results using the "Seven Tools for New Product Planning," such as development of Pioneer mini-component Stereo "MDX707," development of Ricoh digital copying machine "IMAGIO MF-200," and development of Kobayashi Kirokushi sealed postcard "Post de Seal."

In addition, the "Seven Tools for New Product Planning" contributed to developing the Ricoh CD-R/RW Drive "MP6200 series", forecasting orders for Nissan "Stagea", developing Tombow Pencil correcting tapes and developing Nissan "X-TRAIL." It is considered that the effectiveness of product planning by applying the systematic tools mentioned in "Seven Tools for New Product Planning" has been verified by the examples mentioned above. Not all of the seven tools mentioned in "Seven Tools for New Product Planning" were used for each application, and the ways in which these tools were applied differed according to the specific conditions prevailing at each corporation and for each product. As products developed to date are introduced in this article, the tools used for planning these products are what "Seven Tools for New Product Planning (P7-1995, former edition)"recommends.

The "Seven Tools for New Product Planning" introduced in this article was well received by the public and made the headlines in Nikkei Business. In the light of these facts, it is expected that publication of the revised edition and a series of practical editions in three volumes have given fresh impetus to seven tools in the future. There are some examples where the revised "Seven Tools for New Product Planning" has already been used for actual product planning and its applications are increasing. When the revision and updating of its content are required, we intend to improve the current edition of seven tools.

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2. Interview Survey: Qualitative survey technique for arriving at assumptions

The Interview Survey involves two methods; Group Interview and Grid Evaluation Method.

2.1 Group Interview

If the primary objective of the questionnaire survey described later is to provide a quantitative survey, then this Group Interview is its qualitative survey counterpart. Group Interview is a method where a small number of consumers are gathered together and their opinions are explored deeply until they are understood. The Group Interviews are performed for one or both of the following objectives.

(1) It is performed when hypotheses about the product to be developed are not clear, Group Interviews are performed so that these hypotheses can be extracted.

(2) To check the hypotheses the planners have.

2.2 Grid Evaluation Method

Characteristics of Grid Evaluation Method are as follows:

(1) Products are presented in paired comparison and the evaluation is recorded in his own speaking. Interviewer never leads the evaluation so the roll of interviewer is simplified. The skill of interviewer, time and place of interview are less effected.

(2) It is easy to make a hierarchical structure modeling of the results.

(3) Using the whole structure modeling the latent needs of customer can be revealed from the usual point of view.

(4) In spite of the above, the results are effected by the choice of the samples to be presented and the free and liberated opinions derived in the group interview are hardly obtained. These two methods are complementary to each other.

Figure 2 shows a brief example of the evaluation structure drawing for PC of Grid Evaluation Method.
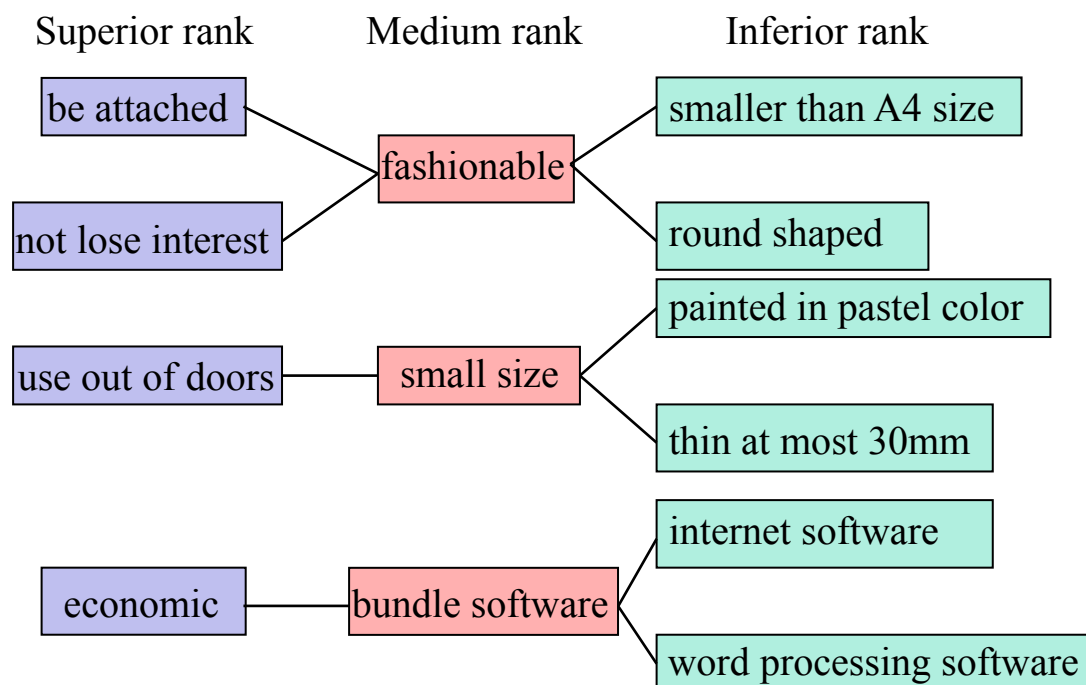

Figure 1: Brief example of the evaluation structure drawing for PC of Grid Evaluation Method

Source: Nagasawa, Shin'ya and Pi-Ju Tsai (2007), *Marketability of Environment-Conscious Products: Application of "Seven Tools for New Product Planning,"* Koyo Shobo, p.174, Figure 2.

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3. Questionnaire Survey: Quantitative survey technique for verifying hypotheses

This approach quantitatively examines assumptions acquired from Interview Survey (group interview and/or Grid Evaluation Method) that collect replies from a large number of consumers.

Care should be taken in setting questions and answer options, and reviewing expressions. Determination of target segment and sampling method should also strictly made.

3.1 Significance of Questionnaire Survey

While the Interview Survey is typical of qualitative surveys, the Questionnaire Survey is typical of quantitative surveys. Even if the same questionnaire is used (or in other word, even if the survey asks the same questions), the various methods by which the surveys are performed are categorized how the survey form gets filled in (i.e. mail surveys versus drop-off surveys, telephone surveys, interviews, etc.). There is also a variety of ways in which the subjects can be sampled, such as the random sampling method (often used in public opinion surveys), relying on contracted monitoring organizations, the method of using responses from product or service users, etc. Each of these methods has its strengths and weaknesses. In terms of the format, the most reliable method is to have expert researchers visit the appropriately sampled respondents in person to perform an interview thus obtain results; however, this is extremely costly, and often the researchers lack experience because they are only part-time workers, leading to problems. Mail surveys are quite common, and while they are inexpensive, they have long lead times, and unless some type of reward of incentive is included, the response rate will be poor, leading to biases. However, in all of these cases the following points are the same:

(1) The same questions are given in the same order to all the respondents.
(2) Normally the responses are categorized in advance (or afterwards).
(3) Although room is left for the expression of free opinions, open-ended questions are not central to the survey.

3.2 Design of Questionnaire Survey form

The questionnaire form for part of the Seven Tools for New Product Planning uses either the SD (semantic differential) scale method where a pair of antonyms are placed on either end of a scale, or uses the Rating Scale method as shown in Figure 2.

(a) Semantic Differential Scale method

(b) Ordered categorical scaling method

Figure 2: Ordered categorical scaling method
Source: Nagasawa, Shin'ya and Pi-Ju Tsai (2007), *ibid.*, p.177, Figure 3.

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4. Positioning Analysis: Method of positioning products and directing planning

Using the results of the quantitative survey (questionnaire survey) conducted on the preceding step, the product manager should successively apply the Positioning Analysis, which is a technique to identify a product's place in the market, and to clarify the direction of development as shown in Figure 8. He should better implement the analysis using a PC. He will be able to fully understand the advantages of "the Seven Tools for New Product Planning." He should hold active discussions among his colleagues in project team and identify hit-product planning directions.

"Positioning" basically refers to assigning a product a position in the market. Specifically, existing products (including brands, services, etc.) which can be chosen by the consumers are plotted onto a diagram drawn by some type of method which includes some type of basis and some type of shape, and each product is given some position in this plot.

Looking at it from another perspective, the act of creating an expression of a space that is a multi-dimensional space, such as a map, or in other words creating a "positioning map," can be referred to as "positioning." Positioning is sometimes referred to as "mapping" because a "map" is created.

In marketing this space is often created based on the perceptions of the customers in response to what the customers think of the various products. This is because this element of "perception" or "image" is thought to have a huge influence on product selection decisions. For example, the "attractiveness" of an automobiles owned by a typical customer is thought to be structured from several subjective characteristics such as "it feels sophisticated" or "it feels individualistic" rather than by the product specifications of the automobile itself. The positioning of these perceptions is formed not just by the physical characteristics of the product itself, but by the advertising methods, the promotions, etc.
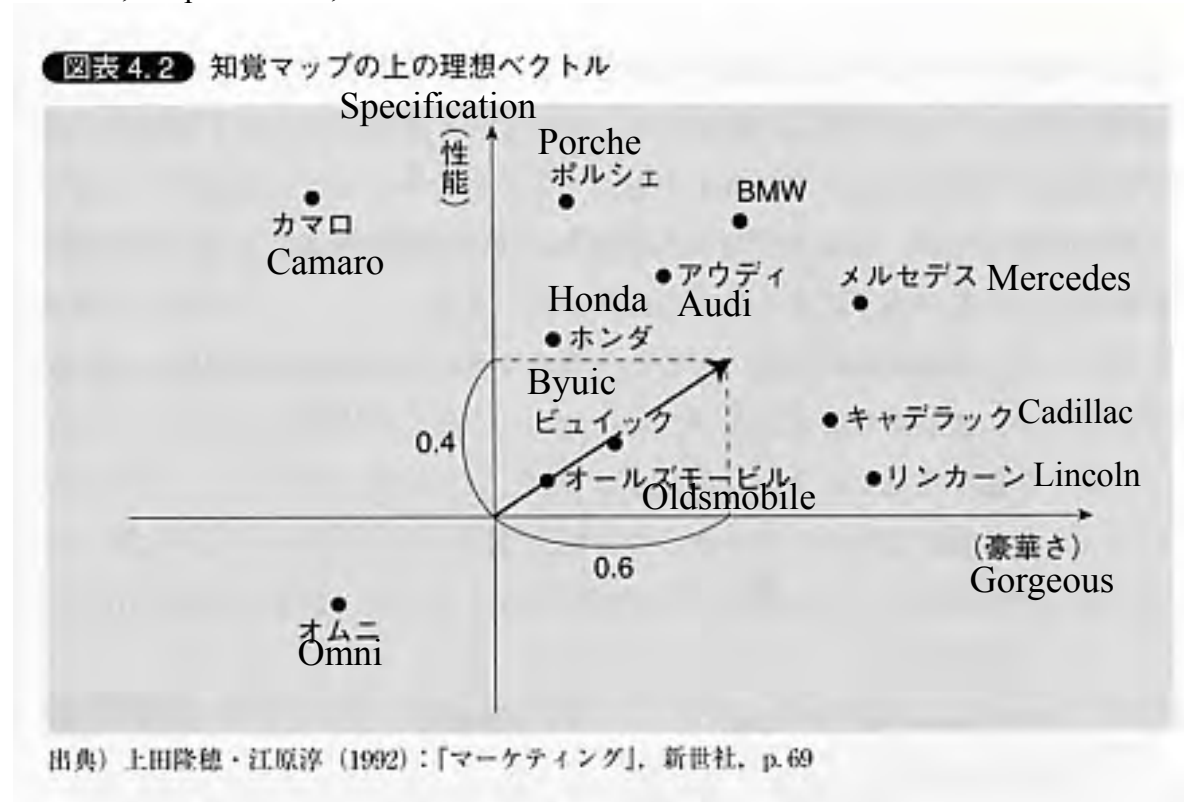

Figure 3: Example of Positioning Map (Preference regression on the Perception Map)
Source: Nagasawa, Shin'ya and Pi-Ju Tsai (2007), *ibid.*, p.186, Figure 8.

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5. Idea Generation Method: Procedure for efficient generation of ideas

The product manager should learn how to generate unique ideas. The manager should also be challenged to generate innovative ideas based on the hit-product planning directions identified by Positioning Analysis. Everyone will learn how to generate surprisingly unique ideas.

5.1 Significance of Idea Generation

Modern business and businessperson must find ways to produce excellent results with limited time and limited budgets. There is especially great interest in new product development because whether or not new hit products are sent to the market in a timely manner has a direct impact on the firm's bottom line.

Over 100 creativity and idea generation methods have been published throughout the world. We make no attempt to categorize and introduce all of these, but rather will narrow our focus on five useful tools for product planning;

(1) Analogy Idea Generation Method
(2) Focus Idea Generation Method
(3) Combination Idea Generation Method
(4) Idea Checklist Method
(5) Seeds Idea Generation Method

5.2 Analogy Idea Generation Method

In situations where the seeds for known needs are not yet ready, or situations where the product image just does not seem to come into focus, then the Analogy Idea Generation Method is used. In this method one creates an analogy with the "keywords" (key ideas for generating new ideas) for focusing in on and solving the problem, and then through combining these keywords with the topic is able to generate ideas. When using the Analogy Idea Generation Method, the subjects should not resemble each other externally. Although it is important than they are similar in essence. Because of this, selecting a completely unrelated subject for the analogy will result in the discovery of a broad range of rich ideas.

In order to use Analogy Idea Generation Method effectively, it is important that the problem be clearly specified, and that the keywords provide direction for problem solving. This is based on the assumption that the members are good at changing their feelings. If the members can completely relax, many analogies will be put forward. Afterwards, all that needs to be done is for one of the more experienced members to flesh out the idea. Table 1shows results of Analogy Idea Generation.

Table 1: Results of Analogy Idea Generation (Example of hit website)

No.	Common sense	Reverse	Problem	Key word	Analogy	Idea
No.1	Useful for a hobby	Not useful for a hobby	Necessary to buy technical magazines	Never miss the target	Large family	A site for increasing new hobbies
No.2	Useful for study	Not useful for study	Necessary to attend a class	To recruit a substitute student	Pinch hitter	A site for having a paper written by a substitute student
No.3	Useful for writing a paper	Not useful for writing a paper	Failing the course	To make friends with someone seated at the front of the classroom	Short-term contract	A site serving as an intermediary for concluding a short-term contract to get a paper written
No.4	Useful for club activities	Not useful for club activities	Cannot find match opponents	Reliably facilitating contact between potential opponents	Intermediary	A site serving as an intermediary for arranging matches for sports circles

Source: Nagasawa, Shin'ya and Pi-Ju Tsai (2007), *ibid*., p.194, Table 9.

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6. Idea Evaluation and Selection Analysis: Method of evaluating and objectively selecting ideas

Idea Evaluation and Selection Method consist of two methods; the Weighting Evaluation Method and the Paired Comparison Evaluation Method.

The product manager should learn how to select unique ideas, and to optimize them.

Significance of idea evaluation and selection, and the proper use of the Weighting Evaluation Method are to be explained. The Paired Comparison Evaluation Method is omitted for explanation.

6.1 Significance of Idea Evaluation and Selection Analysis

It is often true that it is difficult to evaluate and select (narrow down) good ideas generated using the idea generation methods in P7-1995 (former edition). Nevertheless, there was no tool to cope with these situations.

Therefore, tools which allow ideas to be evaluated from several criteria and then selected synthetically have been added as ways of narrowing down ideas. Specifically, the Weighting Evaluation Method and the Paired Comparison Evaluation Method (AHP) have been adopted.

The Weighting Evaluation Method is a way of rating each idea generated by customers or persons in charge of evaluating products. The ideas are weighted alongside each evaluation criteria including charm, originality, practicality, level of technical difficulty and cost. Although this method is easy to apply, products are likely to be weighted or rated from a personal point of view.

The Paired Comparison Evaluation Method (AHP) is a way to estimate weight and scores by comparing a pair of products or evaluation items. In the case where there are many evaluation items and ideas, the number of paired comparisons increases and their objectivity also increases correspondingly.

6.2 Weighting Evaluation Method

Using the Weighting Evaluation Method, ideas were evaluated according to each evaluation item against different criteria, to obtain the overall evaluation of each idea.

Table 2 shows results of the Weighting Evaluation Method

Table 2: Results of the Weighting Evaluation Method

Ideas	Novelty ($\times 3$)	Practicality ($\times 2$)	Feasibility ($\times 1$)	Overall evaluation	Prospective
A site for obtaining a smattering knowledge on various topics from quiz programs	0	3	1	7	○
A site for accessing beautiful passages from great writers	2	2	1	11	◎
A site for getting ideas for new hobbies	2	3	1	13	◎
A site for correcting sentences	0	2	2	6	○
A site serving as an intermediary for arranging matches for sport circles	2	2	2	12	◎
A site about certificate courses	0	0	2	2	
A site for making friends with celebrities	0	0	2	2	
A site for renting useful things for leisure activities	1	2	0	7	○
A reverse-direction site (a site that sees a user)	0	2	1	5	

Source: Nagasawa, Shin'ya and Pi-Ju Tsai (2007), *ibid*., p.196, Table 10.

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7. Conjoint Analysis: Technique for identifying optimal concepts

The product manager should learn how to apply scientific and clever approaches in order to refine complex ideas, and to derive optimal concepts.

The purpose of Conjoint Analysis is to estimate simultaneously the effects of individual elements with conjoint scales when rank order relationships of the multi-dimensional combinations of elements has been established. The analysis of objective variables on ordinal scales has been developed in various fields such as psychology; however, this type of analysis quickly drew the attention of consumer research and of the field of marketing as a method by which preference analysis could be performed.

In the field of marketing research, conjoint analysis was defined as a method for deriving the worth (or utility) value for each different level of an object (the product, etc.). Also, this worth value is not a preference for an individual attribute, but rather is evaluated based on the full set of preference data regarding a "bundle of attributes," which data defines a product or a hypothetical product. Also, Noguchi and Isogai (1992) discuss conjoint analysis as follows:

"Conjoint Analysis is a method for calculating measures for individual evaluations o* each factor in such a way that these evaluations will be as reproducible as possible, where the calculations are done from an overall preference evaluation of the subject (the product, etc.) using a combination of elements prepared in advance."

Niki and Asano (1979) explain the name "conjoint analysis": The name "derives from the fact that while the value of a tangible or intangible product is the effect of a host of attributes (size, weight, style, etc.), these jointly exist in a single product, and are indivisible."

The starting point for theoretical research regarding conjoint analysis was with the public attention garnered by the paper written by Luce and Tukey regarding the effects of measuring individual explanatory variables in relation to an ordinal-scale objective variable, presented in 1964 by the psychologist Luce and the statistician Tukey. Following the paper, theoretical research in this field progressed rapidly the late 60s, and many paper were presented even in Japan by the likes of Ohsawa, et al. (1980,1984) and Katahira(1984).

Recently, conjoint analysis has moved beyond marketing and is used in many fields. Also there are many varieties of techniques which are all referred to by the term "conjoint analysis" so it is difficult to produce a general definition which includes them all. However, we can summarize the positioning of conjoint analysis as a preference analysis tool in marketing as follows:

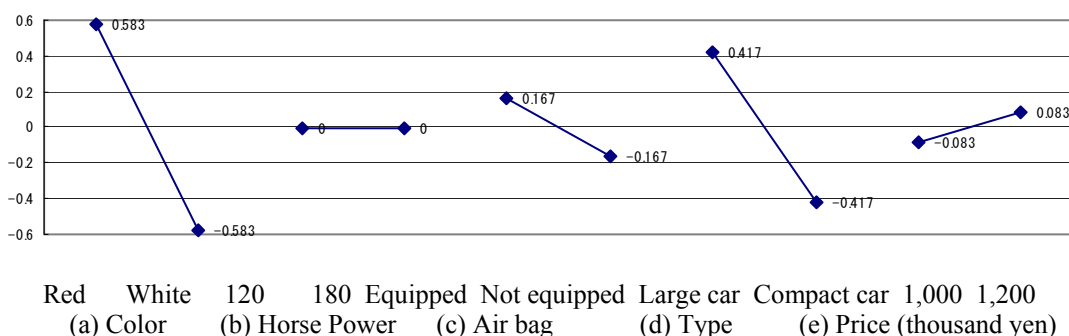"Methods to derive the partial worth values for each factor (including methods such as preference regression)"

| Red | White | 120 | 180 | Equipped | Not equipped | Large car | Compact car | 1,000 | 1,200 |
| (a) Color | | (b) Horse Power | | (c) Air bag | | (d) Type | | (e) Price (thousand yen) | |

Figure 4: Results of Conjoint Analysis (Utility Value)
Source: Nagasawa, Shin'ya and Pi-Ju Tsai (2007), *ibid.*, p.201, Figure 11.

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8. Quality Tables Method for linkage of Planning and Design

Quality Table is well-known in QC in Japan as a method for linkage of Planning and Design.

Although the concept can be made more concrete by employing the demanded Quality Deployment approach, the product plan can be made more concrete by deploying it into technical characteristics. As described above, Quality Tables are charts for converting customer requirements into technical characteristics. Even if the customer requirements are under-stood, if the firm is unable to convert these into technical quality characteristics then it will be unable to fully specify the product.

For example, a substitute characteristics for the customer requirement is "easy to carry around" might be "mass" and if no specific value such as "500 grams" is determined as the design value of this characteristic, then the product cannot be manufactured. The product can only be manufactured after specific design values are selected – and not just for the characteristics "mass," but for "length" and "thickness" as well.

These quality characteristics of "length" and "thickness" may have some relationship to actualizing the demanded qualities "easy to receive" and "easy to handle," so it is necessary to add these demanded qualities as well and decide on their design values.

To do this, a matrix is drawn using the demanded Quality Deployment chart and the quality characteristic deployment chart, and the customer requirements are specified more concretely by showing the relationships between the customer requirements and the technical characteristics. The Quality Table is made and used following this way of thinking. Although the quality characteristic deployment chart deploys the quality characteristics of the product, planned product is specified more concretely by setting design values for these quality characteristics.

9. Concluding Remarks

We proposed "the Seven Tools for New Product Planning," those are selected from various types of tools, including marketing and QC, and combined them into a set. These tools consist of Interview Survey, Questionnaire Survey, Positioning Analysis, Idea Generation, Idea Evaluation and Selection Analysis, Conjoint Analysis and Quality Tables. The outlines of these seven tools are explained in this article.

For further details, please refer bibliographies.

It is our hope that these tools will be broadly applied.

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